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the glass industry

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THE GLASS INDUSTRY

VOLUME 33, NUMBER 1, JANUARY, 1952

THE GLASS INDUSTRY IN 1951

By ROBERT F. FERGUSON

Zanesville, Ohio

Business Activities

Historians generally agree that the fall of Rome occurred in A. D. 476. And yet, if you had been living in Rome at that time, you would have thought that 476 differed little from 475 or 477. Certain events took place, to be sure, but these events were merely continuations of trends that had been going on for a long time and, for anything that could be foreseen, would continue for a long time to come.

It is possible that future historians will settle on 1951 as marking the year in which the republican form of government of the United States was taxed out of existence and a form of statism substituted as the only type of government capable of supporting the tax structure that had been evolved. With a tax take considerably in excess of the total national income in 1933, with a spending program that would require a 100% levy on all personal income above $4000, and with "appropriations" several times what can possibly be spent, it is obvious that fundamental changes in our way of living will be necessary.

For one thing, such a tax haul requires a wide base of taxable liquid assets; and a wide tax base requires an enlarged national economy. To insure this wide tax base, artificial stimuli of business must be used, such as waging war in remote parts of the world, subsidies, and government purchases. War itself must be carried on by methods that will result in greatest industrial activity regardless of military strategy. Materials and expenditures will be channeled by government directive into activities that promote the most taxable income regardless of the relative needs of the citizens. To assume that consideration of such matters does not belong in a technical article is to invite an unpardonable provincialism.

The conditions outlined above are well illustrated by earnings of corporations. With production at record levels both in dollars and in units of quantity, all companies report low earnings. The difference has been absorbed by taxes, either directly by taxes on the corporations or indirectly by taxes on the earnings of the workers. Although the latter item will appear in the annual statements as higher labor costs, in most cases higher wages are merely an effort on the part of the employer to help cushion the tax levies on the workers.

In respect to the effect of taxation, the glass industry is no exception. Examination of the published reports of leading glass companies shows the same pattern as all American industry. Total dollar sales are universally larger in 1951 than in 1950, which year in turn is larger than 1949. The increase ranges from an amount that could be attributed to the shrinkage of the dollar to as much as 50% greater than the year before. Production in units of quantity show the same general increase. In spite of this high level of operation, net profits have remained stationary or have barely offset the decline in purchasing power of the dollar. Least gains have been shown by firms that are strictly glass manufacturers, while greatest increases have been shown by companies who have broadened out into a diversity of products other than glass.

Fiber Glass

Most active development took place in the fiber glass field as would be expected from a relatively new industry. New production units completed or started during the year include the following: Fiberglas of Canada, Ltd., Guelph, Ontario; Glass Fibers, Inc., Defiance, Ohio; Owens-Corning Fiberglas Co., Anderson, South Carolina; and Libbey-Owens-Ford Co., Parkersburg, West Virginia.

In addition to the above, a stock sale by Glass Fibers, Inc. provided capital for a projected plant in California.

The conversion of the Parkersburg, West Virginia plant of Libbey-Owens-Ford to fiber glass and the announcement by Pittsburgh Plate Glass Company and Ferro Corporation that they would enter the fiber glass field is of interest not only because this represents the entry of new producers into the field, but also because it is a drastic product diversity for well-established companies. The Ferro plant is to be located in Nashville, Tenn. A technical innovation which may be of great importance was introduced in the Owens-Corning Anderson, South Carolina plant where fibers are made directly from raw materials without first being made into marbles.

Fiber glass continues to seek new applications and to

extend the present ones. Although the following uses are not new, important developments have been announced during the year. After several false starts, the producers are again ready to market fiber glass curtains and draperies. Problems that have stood in the way in the past have been to secure decorative effects and necessary lubrication without increasing flammability. Another announcement which may be an important milestone has been the successful making of paper in a regular paper-making machine using glass fibers in place of some of the wood fibers. The possibility of reinforcing paper with glass fibers has long been an intriguing goal for the industry, and some industrial tape reinforced with woven glass fabric is on the market. The new process, however, puts the fibers right into the paper and was made possible by the production of fibers of much smaller diameter than were formerly available.

Hulls for small boats have been made by building up alternate layers of fiber glass fabric and plastics. This year saw important developments in this direction. More boats were built than ever before and much larger ones, including one equipped with sail power. The greatest significance of glass boats lies in the fact that the history of society shows that many revolutionary inventions originated as amusement or recreational devices. The bicycle and its offspring, the automobile, are obvious examples. The latent possibility that an invention might have a widespread recreational appeal is always a matter of importance.

For ten years, plastics reinforced with glass fibers have been dangling before the eyes of industry as a tantalizing new material for the fabrication of many products now made of wood or metal or of new products not even possible now. Although the fiber glass industry has the capacity to produce a great deal of this glass-plastic hybrid, very little has reached the civilian market. The necessary plastics are in short supply and there is a tendency for the military purchasers to bottle up the output of glass-plastic products even more than the raw material situation warrants. Production of plastics reinforced with fiber glass is now at a rate of 9 million pounds annually, which is all sold to purchasers with high priority. The fiber glass industry claims to have facilities to triple this production if plastics could be obtained and if allocations were removed. In spite of this inability to develop markets, research has continued in this field. As the product has what the biologists call "hybrid vigor", it can be expected to erupt on the world some day with far-reaching effects.

Still another use of fiber glass that has prospects of wide application is an insulated fiberboard container for frozen food products which was announced by Owens-Corning Fiberglas Corporation in May. Such a package will facilitate the distribution of frozen foods and will enlarge the areas over which they can be supplied.

Containers

The year 1951 was a busy one for the glass container industry. At the start of the year, an annual production of 140 million gross was freely predicted and some concern was felt as to how the industry could meet the demand. Business leaders in the container field warned the government that too many restrictions on the use of metal would create a gap that the glass industry could not fill. After a flurry of activity early in the year, there was a slight easing of demand and monthly production hung close to 10 million gross during the middle of the year. Unless an unforeseen slump develops in the last quarter, the total production of containers for 1951 will be 120 million gross for a new record, slightly exceeding the 116 million gross peak year of 1946 and 13% greater than the 106 million gross of 1950.

The discrepancy between the predictions at the first of the year and the actual production was due in part to the off-again-on-again orders for the use of tin. Restrictions on the use of tin cans for certain products were announced on a tapering-off scale which was to have started in the second quarter with a reduction of 25% below 1950 consumption, and was to have decreased at the rate of 25% per quarter until 1952 when no tin would be used by the prescribed products. However, resistance by the users, reduced consumer demand, the decision of the government not to stockpile at current prices, and other factors slowed down the execution of the orders, and by late fall, brewers and dog-food makers were receiving 70% of their 1950 consumption.

An amusing sidelight on the tin situation was a resolution introduced into Congress to prevent the control bureaus from restricting the use of any raw material by highly taxed industries such as brewing. If there was not enough material to go around, some congressmen thought that the best taxpayers should have first choice.

Three new container plants began operations during the year. Metro Glass Company, operating through a subsidiary, the Washington Glass Company, began production at a new plant in Washington, Pennsylvania. Brockway Glass Company got underway with their completely rebuilt plant at Lapel, Indiana, and Thatcher Glass Manufacturing Company put into production a completely new factory at Lawrenceburg, Indiana.

In addition to the new plant facilities, two new research laboratories dealing with container manufacture were opened. Knox Glass Associates moved into their new laboratory at Knox, Pennsylvania, and Anchor Hocking Glass Company completed a building at Lancaster, Ohio, which is intended to be the first of a group comprising a research and development center. Another laboratory not dealing with containers is the Owens-Illinois Glass Company's daylighting laboratory for the study of glass blocks. Although the laboratory is several years old, its existence was made public this year. Of special interest are the facilities for large test constructions.

Flat Glass

Flat glass enjoyed what seemed like an insatiable demand. The principal producers reported record sales both in units and in dollars. The all-time record made in 1951 exceeded by a wide margin 1950 production which itself had been the previous record year. This demand for flat glass has been interpreted by some economists as indicating a flight from the dollar. Large quantities of flat glass are used in automobiles and houses which are large durable goods purchased for individual consumers.

To meet this demand, new plants have been or are being constructed. Libbey-Owens-Ford began construction of a new plant at Rossford, Ohio. Canadian Pittsburgh Industries, Ltd. opened a new window glass fac-

tory at Ville St. Laurent, Quebec. Pittsburgh Plate Glass Company began production at a new plant at Torrance, California, and started construction on another at Atlanta, Georgia. In the opposite direction, Libbey-Owens-Ford during the year sold the last of their European holdings to a Belgian syndicate. In addition to the plant construction, American Window Glass Company began to build a research center at Monroeville, Pennsylvania.

New developments in the flat glass field included the installation by Libbey-Owens-Ford of the double pane type of glazing for the first time on steamships. Pittsburgh Plate Glass Company developed a glass-plastic laminated window to reduce flying glass resulting from explosions. The growing use of military action against civilian populations gives this development a timely interest.

A new note in promotional activity was sounded during the year when flat glass manufacturers began selling landscaping to owners of picture windows. Basically, the approach is not too different from the preparation of canning guides by the makers of fruit jars. After selling the product, the manufacturer helps the customer to fill it.

In addition to its use for other purposes, glass is steadily becoming a selective filter to transmit or retard radiations of specific frequencies. While these uses of glass do not require large tonnages, their importance to human welfare make them of great value. To the long list of glasses designed for the selective absorption or transmission of specific rays, Kuan-Han Sun* has added a glass which is capable of absorbing slow neutrons. Glass had previously been devised to absorb gamma rays and X-rays, but uncharged particles had resisted absorption. The new glass stops slow neutrons, but the problem of fast neutrons remains unsolved. Other research in this field was directed towards improving glasses for the absorption of transmission of infrared and ultraviolet radiations.

An event of great historical importance was the sealing of the Declaration of Independence and the Constitution of the United States in an atmosphere of helium in an envelope of light-protection glass. The skill and knowledge of a number of scientific workers were called on for this project. The technical details have been fully described elsewhere; but to realize the historical importance, it will be necessary to imagine what would have been the effect on world history if the country had been under the control of a group who wished the documents destroyed. At least the statism required by our tax structure will be fitted into the framework of our constitution leaving the door open to a return.

Lamps

During the year, there was great activity in the lamp and tube industry. Television tubes passed out of the land office period of 1950 and settled into steady production. Greatest activity centered on the more established products. Westinghouse Electric Corporation began the production of their own envelopes for lamp bulbs, supplementing their manufacture of tubing for fluorescent lights that had begun five years ago. New plant construction for Westinghouse during the year included light bulb factories in Quebec, western Alabama, Hot Springs, Arkansas, and Paris, Texas. New plants for the manufacture of electronic tubes were begun at Elmira and Bath, both in New York.

Corning Glass Works responded to the demand for radiant energy with a new television tube plant at Albion, Michigan, which began operations during the year and by the start of construction on a plant at Danville, Kentucky for the production of bulbs and tubing. In addition, a new subsidiary was established at Monterrey, Mexico. This new division has been patterned after the three other Latin-American subsidiaries set up by Corning in recent years.

An entirely new method of lighting was announced by Sylvania Electric Products, Inc. In this process, sheets of conducting glass are coated with phosphors which become luminous under the influence of an impressed voltage. The result is a panel of light whose candle power varies with the voltage. By going from the lamp bulb, to the fluorescent tube, to the luminous panel, the lighting industry completes the "geometric progression" from point through line to area. All that remains in a three-dimension world is the development of luminous space.

In the field of technology, General Electric Company announced a new glass-to-metal seal. The disclosures show that both glass and metal are painted with titanium hydride and soldered. On joining the parts and heating in a vacuum, the hydride decomposes, leaving an interface of metallic titanium between the solder and the glass or metal.

Tableware

The handmade tableware industry continues to complain about imports. This attitude has been chronic with the industry for many years and although American labor rates as compared to those of foreign countries are a primary cause of their difficulties, apparently the industry, or at least their spokesmen, prefer to fight it out along tariff lines rather than to direct their efforts to plant modernization and possible price adjustment. A pleasing exception was the announcement early in the year that Fostoria Glass Company had developed a new automatic etching process.

A quiet revolution in the tableware industry has been going on unnoticed during the past several years. It is now possible for a consumer to go into any department store and buy good-looking tableware in the price range of twenty-five to fifty cents per item. A few years ago, there were mass-produced items at five cents or handmade ware at a dollar or more with nothing in between. This change has been brought about by the entry of mass producers into the fine tableware market.

Special Glasses

In the field of special glasses, Corning Glass Works unveiled a new glass capable of receiving a photo-etching. This glass is a third in a series of photosensitive glasses invented by S. D. Stookey. In the new process, the special glass is exposed through a negative to ultraviolet radiation. On heating, the exposed portions undergo a devitrification, leaving a residual glass matrix which can be readily dissolved in acid. This combination of radiant exposure, heat treatment, and acid leaching makes possible intricate sculpturing or complicated patterns of

* The Glass Industry, October 1950, p. 507.

holes. One use already suggested for the product is the making of chassis for printed circuits for electronic equipment.

On the dark side of the picture of special glass products is the news that Akro Agate Company, makers of toy marbles, was sold at auction.

Antitrust

Business has been relatively quiet in the "antitrust industry" but the baying of the hounds can be heard on clear nights. During the year, several old actions were completed. A final decree was issued in the old alkali export case. In a belated action on the Fourcault case, the court set the price on a stock transfer required by the decision. As the result of a suit filed in 1940, Bausch & Lomb Optical Company and the American Optical Company were fined $975,000.

As a hint of things to come, the Federal Trade Commission viewed with considerable noise what they chose to describe as "secondary interlocking directorships".

History and Art

A most encouraging trend has received considerable publicity during the year. More interest is being shown in the historic and artistic phases of glass. Leading, perhaps, in importance was the opening to the public of the Corning Glass Center where valuable exhibits and documents are carefully housed under the care of qualified curators and librarians. On a smaller scale, the Libbey Glass Division of Owens-Illinois Glass Company staged an exhibit of historical glassware at the Toledo Museum of Art. The transfer of the Silverman collection to Alfred University received publicity. That this interest in the "belles lettres" of the industry is of deeper significance than the enthusiasm of a few firms is shown by the increasing amount of space given in trade and technical journals to articles on the history of glass and its place in various cultures. This trend in the glass industry is encouraging because lack of historical and geographic perspective has always been a blind spot in American opinion and any move to fill this gap is welcome.

Shortages

The glass industry entered 1951 braced for a siege of shortages. Through careful planning by the industry and judicious exercise of controls by the government bureaus, most of the shortages were less severe than had been feared. Rapid tax write-off of new production facilities for basic products also contributed. By June, adequate supplies of soda ash and paperboard seemed assured and by August, almost all shortages were eliminated. Exceptions were selenium, cobalt, and copper. In spite of drastic allocations of selenium and whole-hearted voluntary reductions by the glass industry, the selenium demand in September was still 50% above the available supply and the NPA found it necessary to extend the conservation plan to limit all industrial users as well as glass. September figures showed also that more strict control of cobalt would be needed. And, so far as any student of the statistics can foresee, copper will be scarce for a long time to come.

In response to an inquiry from THE GLASS INDUSTRY as to the outlook for glassmaking machinery, Charles H. Pearce, Special Industrial Equipment Branch, General Industrial Equipment Division of NPA, has this to say: "We believe we can best give you our ideas concerning the outlook for the glassmaking machinery industry by outlining our approach to the industry needs which are controlled by the National Production Authority.

"Full recognition is given in the National Production Authority to the importance of all segments of glassmaking machinery in our over-all national economy.

"In order to maintain glassmaking machinery at the highest possible level needed in relation to the defense effort, we in the General Industrial Equipment Division keep in close touch with glass machinery requirements through controlled material and other applications. We also keep in close touch with other divisions of NPA and their requirements, allocations, and the rates at which industry products made by glassmaking machinery are supported. For example, Container and Packaging, Consumers' Durable Goods, Electronics, Building Materials, and other Divisions.

"Articles and statistics published in industrial magazines such as yours also serve to keep us abreast of the various industry activities and are indeed helpful."

Science and Technology

A steady release of the findings on basic research on glass has come forth during 1951. No better measure of the increase in the volume and depth of glass research can be found than a comparison of the fall programs of recent meetings of the Glass Division of the American Ceramic Society with the programs of ten or fifteen years ago.

It is not the purpose of this article to rehash published data, but rather to indicate what seems to be outstanding contributions for the year. In appraising recent publications, considerable risk is involved. Some of the most important work in science has been rediscovered twenty or more years after it was published, and many publications thought important when first issued have led to little of value either in promoting theory or in practical application. At a 50-50 risk of being wrong, I have selected publications and groups of publications that promise to be of permanent value.

A paper by Howard O. McMahon dealt with thermal radiation of glass. Infrared absorption has been fruitful in revealing the structure of organic compounds, as various linkages have characteristic absorption bands. Unfortunately, glass is virtually opaque to wavelengths greater than five microns, and the method of infrared absorption, therefore, had limited application in glass research. McMahon has now developed a method which permits measuring the reflectivity at selective wavelengths and, as strong absorption bands are associated with high reflectivity, the infrared studies can be extended into the opaque regions. Already, a strong reflectivity at 9.5 microns has been identified as due to the primary Si-O linkage. Further investigation with this tool can be expected to yield information on the structure of glass.

A paper early in the year by Katherine Blodgett described the production of electrical conducting glass. This paper is a continuation of work published by the same author in 1948. Two facts make this paper of more-than-average interest. One is Dr. Blodgett's repu-

(*Continued on page* 42)

G.C.M.I. MEETS IN MIAMI BEACH

The fall meeting of the Glass Container Manufacturers Institute was called to order by President and Board Chairman Joseph C. Feagley on Wednesday morning, November 28, at the Sea Isle Hotel in Miami Beach, Florida. Although a number of members who are always present were, for one reason or another, unable to attend, the over-all attendance was the largest for a Miami meeting.

After the reading of the minutes of the previous G.C.M.I. meeting held at The Greenbrier in May, Mr. Feagley as president of the Institute delivered his report to the assembled members. Other reports followed from Fred E. Fuller, General Counsel, Victor L. Hall, General Manager, R. L. Cheney, West Coast Manager, and Harry W. Kuni, Secretary-Treasurer.

Before adjournment of this session, it was announced that the Annual Meeting for 1952 was scheduled to take place at The Greenbrier, White Sulphur Springs, West Virginia.

The second day's session was devoted to a talk by C. C. Merrifield, Vice President and Consultant, The Econometric Institute, Inc. Mr. Merrifield's subject was the "General Business Outlook for 1952, with Special Reference to the Glass Container Industry".

Unlike so many economists, Mr. Merrifield did not burden his audience with a lot of dry and confusing statistics, but spoke interestingly and in a manner so that he could be followed without the aid of a slide rule. He was optimistic for the foreseeable future of the glass container industry.

At the final session on Friday morning before the presentation of reports by the nine standing committees, it was announced that Hazel-Atlas Glass Company had made known its intention of becoming a regular member of the G.C.M.I. It was also announced that an entirely new member had been accepted by the Institute—the United Can and Glass Company, Hayward, California.

Immediately following supplementary oral comments to the written reports of their committees by Ralph A. Lind, Committee on Labor Relations, Bert W. Hendrickson, Advisory Counsel to the Committee on Testing Procedures, and S. B. DeMerrell, Committee on Government-Industry Relations, the membership enjoyed an interesting and stimulating talk by its distinguished guest, Manly Fleischman, Administrator, National Production Authority.

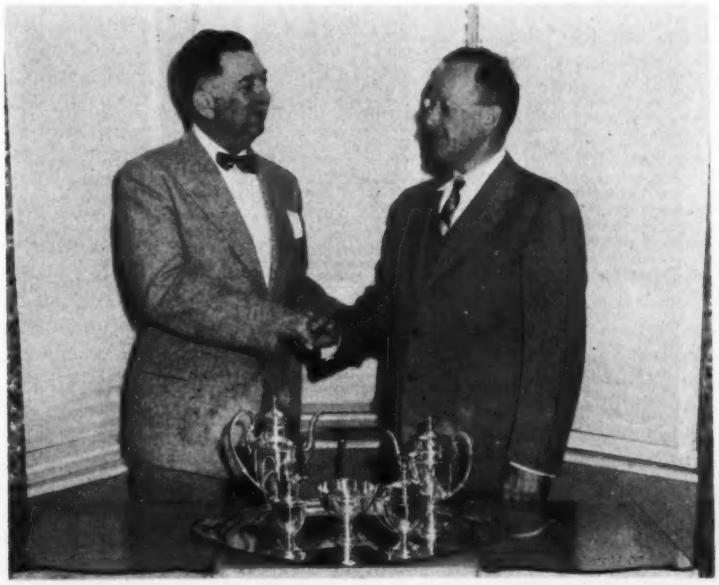
Mr. Fleischman's remarks did not take on the aspect of a "prophecy of doom" with an admonishment that all 150,000,000 of us be good boys and girls and do just what the government wants us to do—the usual official Washington approach. But, to the contrary, he struck a note of "considered optimism", both for our economic future and military power for defense.

In its broad concept, Mr. Fleischman stated that N.P.A. was planned in three parts: Part 1, military; Part 2, industrial production-expansion; and Part 3, maintenance of some level of civilian production.

He said that the N.P.A. had rejected the idea of all-out war production in favor of maintaining a desirable degree of civilian production. He pointed out that no military program, short of all-out war, could take up the slack if civilian production were seriously cut. The inevitable result would be disastrous economic dislocation.

Under present operations, Mr. Fleischman pointed out that civilian production has no appreciable effect on military production. Military demands are met through priority where required and cuts will be made in civilian production whenever it is felt that it is interfering with military production.

In touchng on specific materials, Mr. Fleischman emphasized copper, nickel, and cobalt as the most critical. Aluminum and steel are easier. In connection with material supply, he pointed out that the basic reason for the Controlled Materials Plan was to channel exceedingly



Joseph C. Feagley receives silver service from Royden A. Blunt which was presented in absentia to Mr. and Mrs. Lewis F. Gayner.

short materials. He further stated that while present military production is behind schedule, it is not dangerously so and that more realistic schedules are now in process.

In briefly outlining his recent trip to Europe, Mr. Fleischman said that Europe thinks we could cut off all civilian luxuries and thereby automatically double or treble our military production. This, he stated, is not so. While in Europe, he suggested that we might get needed materials from England, France, and others for materials they need from us—tin at a fair price, for example, lead, zinc, and rubber. Mr. Fleischman found the British in agreement with the idea.

In closing, Mr. Fleischman voiced confidence in our efforts and accomplishments and, when his talk was completed, paid high tribute to William E. Levis for his many contributions to the national planning, both in World War II and the present emergency.

Although, as reported, there were a number of members missing at this three-day meeting, the gathering was sufficiently large to provide a full quota for the Men's Golf Tournament—the prizes were attractive and profuse—the Ladies' Luncheon-Bridge and Fashion Show, the Armstrong Cork Company's enjoyable cocktail party, and the G.C.M.I. cocktail party and dinner.

A scheduled event at the cocktail-dinner party was the presentation of a very beautiful silver service to past-President Lewis F. Gayner and Mrs. Gayner. Unfortunately, Lew and Sally were among those unable to attend the meeting. Nevertheless, Royden A. Blunt, acting as toastmaster, in his competent and inimitable style made the presentation to Mr. and Mrs. Gayner, in absentia, with the following remarks: "In 1935 we lost a poet of whom you will be hearing more and more as his quippery and also almost sublime utterances become better known. I'm speaking of Oliver Hereford who once said, 'my wife has a whim of iron'. And again, 'women's minds are clearer than men's; they change them more often'. And now in gentler vein, he said of the old player's club, 'when I see the flag at half mast, I always rush over to see who it is and always it is the wrong man'.

"That's the way we all felt last summer when we heard that Lew Gayner, our immediate past-President, was ill—'Always the wrong man'.

"But, tonight I'm sure you'll all say that it's the right man and woman to whom we present this old cabinet design silver tea service—to Lew and his gracious lady, Sally."

With regard to the work of the nine standing committees for the past six months, brief resumes of the written reports of these committees follow.

Market Research

Chairman Francis H. May, of the Market Research and Promotion Committee, reported that conditions which dictated the suspension of marketing activities at the end of 1950 have continued throughout the major part of this year and, as a result, the Committee has remained inactive during the past six months.

Out of monies on hand, the Trustees have made two appropriations to finance studies that fall within the scope of activities for which the Market Research and Promotional Fund was established.

A substantial sum was allocated for the investigation

G.C.M.I. Cocktail Party

of causes of food discoloration when processed and means for preserving the natural color when packaged in glass. This study is being conducted at the University of Massachusetts. A smaller sum was set aside for a study of comparative costs of milk bottles and paper containers used by dairies for retail milk deliveries. The U. S. Testing Company is carrying on this study.

Traffic

In his written report, E. G. Siedle, Chairman of the Traffic Committee, briefly eulogized the late B. F. Taylor and pointed out how sorely his passing has affected the work of the Traffic Committee.

Mr. Siedle enumerated the various meetings his Committee has held during the past six months and summarized the complex subjects which were docketed. In the matter of temporary reduced freight rates, which the railroads have established in order to better their competitive position with motor trucks, Mr. Siedle reports that as a result of a conference with traffic executives of Eastern railroads, these lower rates have been made permanent. The result of this decision is a huge saving in freight charges for the glass container industry.

Other matters covered in Mr. Siedle's report were: rail freight rates for glass containers from points in Official (Eastern) Territory to North Atlantic ports for export; reduced freight rates on soda ash applying between points in Eastern Territory; sand freight rates in Eastern Territory; South Jersey motor carrier rates; petition of Central States motor freight carriers for more revenue; the matter of rates to apply to cullet moving between points in Official Classification Territory; and other broad rate and classification problems.

Government-Industry Relations

S. B. DeMerrell, Chairman of the Government-Industry Relations Committee, stated that during the past six months nothing of an untoward nature had occurred in Washington to cause concern to the glass and closure industries.

As this issue goes to press, announcement was made by the National Production Authority of the revocation of Order M-51 controlling the manufacture of glass containers. Details of this order will be found elsewhere in this issue.

Gas producer research at Battelle Memorial Institute was outlined by Mr. DeMerrell. He stated that this re-

search project has moved from the laboratory stage to a pilot plant operation. On October 4, the steering Committee, charged with guiding the work, met at Battelle to observe the producer under actual operating conditions. The unit is so designed that it first decakes the coal by a drastic heat treatment, then gasifies the resulting product in a deep bed. Ashes are removed in dry form, but slag topping is possible. By way of indicating the size of the pilot unit, it is estimated to be capable of firing a 50-ton glass furnace.

The group sponsoring this project, in addition to G.C.M.I., includes Bituminous Coal Research, Diesel Engine Manufacturers Association, General Electric Company, Westinghouse Electric Corporation, and Battelle. At the October 4 meeting, Dr. A. C. Fieldner, of the U. S. Bureau of Mines, was in attendance and preliminary conversations were commenced on the possibility of the Bureau taking a financial interest in the project. Continued participation by G.C.M.I. for twelve months has been approved by the Trustees until June 30, 1952. The G.C.M.I. representative on the Steering Committee is Dr. Harry H. Holscher of Owens-Illinois Glass Company.

The work of the West Coast sub-committee, under the chairmanship of F. W. McDonald, was highlighted by Mr. DeMerrell who emphasized the work of R. L. Cheney with the California Manufacturers Association, Fuel & Power Committee, which it is felt has been very effective in protecting the supply of economical fuel for the glass container and other industries.

Labor Relations

Ralph A. Lind, Secretary of the Committee on Labor Relations, supplemented orally the written report of this Committee's Chairman, L. C. Roche. Mr. Lind highlighted the contents of the report outlining the Committee's recommendations and the industry's attitude on various problems on the labor front.

Testing Procedures

The written report of this Committee was submitted by its new Chairman, Ralph A. Brenner, Anchor Hocking Glass Corporation, who succeeded John H. Steurnagle of Brockway Glass Company. The Committee's report was also supplemented by a brief talk by Bert W. Hendrickson, Advisory Counsel to the Committee.

The work of Dr. Ghering, of Preston Laboratories, was also highlighted in this report.

Glass Packed Products

Since the last report of the Technical Committee on Glass Packed Products, Alex Hart, Anchor Hocking Glass Corporation, has succeeded John M. Sharf as Committee Chairman.

As an introduction to his detailed report, Mr. Hart stated that the work of his Committee has been in the direction of solving some of the glass packer's problems so that an enlargement of the present great values of packing in glass would be achieved. It is the aim of this Committee, Mr. Hart said, to show packers "how to eliminate spoilage and how to produce better looking packs best sold in glass".

The work of this Committee is manifold in its technical approach to better glass packaging of varied products: matters such as pasteurization times and temperatures for bread and butter pickles, thermal destruction of enzymes, relation of ascorbic acid and its oxidation products to non-enzymatic browning, etc.

Royden A. Blunt presides over a special fashion show.

The integration of G.C.M.I. research with that being conducted by the National Canners Association's Baby Food Committee and the G.C.M.I. sponsored work by The Dole Engineering Company on the development of an asceptic canning process for glass packed products were also outlined in Mr. Hart's report.

Standards for Finishes

J. D. Laird, of Owens-Illinois Glass Company, succeeding C. C. Green of Armstrong Cork Company as Chairman of this Committee, presented in brief form the work which has been done on a number of finishes and outlined the appointment of sub-committees, which resulted from an increase in membership of the full Committee. The aim of these appointments is to spread the work of the Committee, to give some of the older members relief, and to utilize to the fullest extent all of the technical talent now available.

Container Design

The Committee on Container Design and Specification, which was headed for several years by J. M. Foster, is now under the chairmanship of G. A. Mengle, who heretofore has been Chairman of the Sub-Committee on Beer Bottles. R. E. Delaplane, of Owens-Illinois Glass Company, succeeds Mr. Mengle as head of this sub-committee.

Mr. Mengle outlined the various activities of the Committee as a whole and its sub-committees on beer and milk, the latter headed by W. A. Seger of Buck Glass Company.

Package Design

Another change in Committee chairmanship is that of Raymond Wells, of Armstrong Cork Company, who succeeds G. C. Noblitt, of Brockway Glass Company, as Chairman of the Committee on Package Design and Specifications.

In the preface to his detailed report, Mr. Wells stated, "The attention of the Packaging Committee since the May semi-annual meetings has been directed in three principal directions: first, certain packaging problems of the glass

(*Continued on page* 46)

EFFECTS OF HIGH-ENERGY RADIATION UPON GLASSES

By KURT O. OTLEY*

During the last years there has been an increased interest in the influence of radiation on glasses and other materials. The effects of ultraviolet radiation upon glasses have been fully described in W. A. Weyl's "Monograph on Coloured Glasses." Its chapter on the fluorescence and the solarization of glass[1] contains an extensive review of the literature on the effect of ultraviolet rays. The present paper deals with a review of the literature on the effect of higher energy radiation upon glasses and incorporates an outline of experimental work carried on at The Pennsylvania State College.

Shortly after the discovery of X-rays and of radioactivity, a number of scientists observed the effects of these radiations on glasses. Berthelot[2] recorded that a glass containing manganese turned purple under the influence of X-rays, in a similar manner as under exposure to sunlight. G. T. Beilby[3] found that potash glass and lead glass became fluorescent and discolored upon irradiation with beta and gamma rays. H. Greinacher[4] observed fluorescence under the influence of alpha radiation and E. Rutherford[5] proved that alpha radiation was the cause of a surface discoloration of a soda glass capillary tube which contained a small amount of radium emanation. The discolored layer had a thickness of 0.04 mm, which was the calculated depth of penetration of alpha rays.

J. C. Maxwell-Garnett[6] reported of experiments which had been carried out by W. Ramsay and F. Soddy. These two scientists had incorporated different metals into various glasses. They then irradiated these glases with rays from a radium salt, particularly beta rays. A glass containing gold showed a red, silver a yellow, sodium a purple, and cobalt a brown discoloration. Maxwell-Garnett attributed these phenomena to the neutralizing effect of the emitted electrons on the charges of the metallic ions in the glass. He concluded that beta rays precipitated the metals in the glass. He attributed the different colors to the difference in size of the precipitated metal particles, in agreement with the findings of Zsigmondy[7].

C. Doelter[8] undertook the first comprehensive study of the effect of radium rays on numerous materials. Most of his observations were made on minerals. He reported that silicate glasses did not discolor to the same extent as some minerals and salts. He distinguished four types of discoloration of glasses: amethyst, smoke-gray, brownish yellow, and golden yellow. He observed that the discoloration produced by radioactive substances could be made to disappear by subsequent irradiation with ultraviolet light.

St. Meyer and K. Przibram[9] studied the effect of ultraviolet radiation on glasses and minerals which had been discolored by beta and gamma rays. Przibram later concentrated on halide crystals, but in a publication on discoloration and luminescence through Becquerel rays,[10] he reported that he could almost completely decolorize a glass which had turned brown under radioactive radiation by heating it for some time at a temperature of only 90°C. He theorized that the Becquerel rays (as they were then called) had changed the sodium ions in the glass into atoms and that the ions were restored in the heating process.

St. Meyer and E. Schweidler's book[11] on radioactivity also contains several pages on radiation effects on glasses. In England Newberry and Lupton[12] subjected glass, as well as other materials, to the action of Becquerel rays.

S. C. Lind[13] observed that alpha, beta, and gamma rays all produced the same color in a certain glass. This color was violet or bluish in most glasses and in fused quartz, brown in lead glass, Jena and Pyrex glass. Prolonged irradiation deepened the color, but Lind never saw one color change into the other. Meyer and Przibram[9] had reported such an observation. Lind found it necessary to heat his glasses close to their softening point of about 500°C. in order to reverse their discoloration. Several months of irradiation with sunlight had the same effect. The discolored glasses were thermoluminescent. A freshly prepared glass showed this phenomenon when it was heated to 60°C., older glasses required temperatures up to 200°C. Lind heated discolored glasses at different temperatures until their phosphorescence was exhausted, and found that the total amount of light emitted up to that point was the same, regardless of the temperature and the rate of emission. Later he observed that a glass which had been stored for 3 years had lost half its radiation power on heating. He drew the conclusion that a slow reversion of the discoloration process took place even at room temperature.

J. R. Clarke[14] attempted to produce a selenium ruby glass by exposing the colorless glass to radiation from radium sulfate. He wanted to replace the standard reheating procedure by a more easily controlled striking method. W. Ramsay had been able to develop a ruby tint to a colorless gold glass which he had exposed to radium emanation for two days. Clarke, however, could not produce the pure red glass which he had wanted; he obtained only a muddy brown color. A blue cobalt glass assumed a similar brown color when it was exposed to radium rays.

Clarke employed aluminum and lead filters in order to distinguish between the effects of alpha, beta, and gamma rays. He found beta rays most active in causing color changes, while alpha rays produced fluorescence and gamma rays did not show any effect within 250 hours. Also irradiation with X-rays produced no changes. Clarke suggested a theory whereby not only the cations but also the anions contained in the glass could produce color changes on irradiation. He believed that the brown color which he had observed in irradiated glasses was caused by the free silicate radical which resulted from the radiation and then was colloidally dissolved in the glass.

In a later publication,[15] Clarke studied the thermoluminescence exhibited by his glasses after their discoloration had reached saturation. He observed the

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length of time required for exhaustion, as Lind[13] had done, and found that the period of luminescence was shortened proportionally as the temperature increased. By extrapolation, he calculated that momentary decolorization would occur at the annealing temperature of the glass. From this result he concluded that the discoloration must be caused by molecular aggregation, as had previously been suggested by J. Ewles. He also proved by chemical analysis that only glasses which contained manganese turned purple under irradiation.

F. Eckert[16] made the observation that the brown discoloration, with ultraviolet light produced in a glass containing 0.1% cerium (larger quantities do not have this effect), could not be duplicated with X-rays. He found out that the discoloration of glass by X-rays could also be prevented by the incorporation of certain amounts of other heavy metals, such as iron, copper, cobalt, nickel, or vanadium. In general, a higher percentage of these metals is required than was found for cerium.

G. M. Shrum, C. G. Patten, and H. D. Smith[17] studied the decrease in the optical transparency which was observed in certain ultraviolet-transmitting glasses after exposure to X-rays or ultraviolet light. They attributed the discoloration to a reduction of the iron contained as an impurity in the glass. Heat treatment restored the original transparency through reoxidation.

M. C. Reinhard and B. F. Schreiner[18] studied "The Production of Color in Glasses and in Gems by X-rays and Radium Rays". They observed brown discoloration of lead glass; purple, of manganese glass; yellow, of bismuth glass.

C. W. Parmelee, G. L. Clark, and A. E. Badger[19] prepared borax beads with various metal compounds and exposed them to X-rays in order to learn to which metals certain color changes in borate glass could be attributed. A bead containing chromium changed from green to yellowish brown, lead from colorless to brown, thallium from colorless to dark brown, bismuth from colorless to orange-yellow, manganese from colorless to purple.

In addition to the borate glasses, a few silicate glasses were irradiated. They were a selenium ruby, a cobalt blue, an iron amber, and a copper-chrome green composition. None of these glasses changed its color. The X-ray machine was operated for 33½ hours at 70 KV and 4 ma.

A. Lecrenier and P. Gilard[20] compared the effect of ultraviolet rays with that of the radiation emanating from radium. Radium radiation produced color changes in the following glasses: manganese glasses turned purple; potassium, yellow; and sodium, brown. This discoloration was much stronger than any obtained with ultraviolet. Lecrenier and Gilard came to the conclusion that ultraviolet rays affected the molecule, but radium rays, the atom. They considered the first a chemical, the latter a physical effect.

Also R. Schmidt[21] irradiated different glasses with X-rays. This radiation was produced by a 190 K.V. X-ray machine. Its intensity peak was at 0.098 A.U. It was the object of Schmidt's investigation to find a glass composition which would not discolor when employed for an X-ray tube. A glass containing 0.5% FeO or small amounts Ce_2O_3 was considered best; also, 0.5% MnO produced only slight discoloration. Smaller percentages of FeO or MnO led to a deepening of the light gray color obtained with 0.5% of either oxide. Cerium glasses remained almost colorless if they contained up to 5% Ce_2O_3, but turned yellow with 10% and orange with 15% Ce_2O_3. Lead glasses discolored more than any other glasses. Their color deepened from yellow in a glass containing 5% PbO to a dark brown in one containing 50% PbO. Also increasing amounts of MgO, CaO, and BaO produced increasing discoloration. A gray color was observed with 5% of either oxide, but a glass containing 25% CaO turned reddish brown, one containing 40% BaO became purple under X-ray irradiation. 10% Na_2O or K_2O produced an orange discoloration; 15%, a pink one; 25%, light blue; 30% Na_2O, blue; 30% K_2O, gray. 10-20% Li_2O or Al_2O_3 produced different shades of gray. ZnO, however, which also causes gray discoloration when added in small quantities, leads to a reddish brown with larger amounts, but to a lighter color in a glass containing 40% ZnO. Also As_2O_3 and Sb_2O_3 produces less discoloration when employed in larger amounts. A glass containing 10% As_2O_3 turned amber, one containing 35% Sb_2O_3 became yellow, while smaller percentages of these oxides produced darker colors. Additions of ZrO_2 resulted in stronger discoloration than those of TiO_2. As most metal oxides were found to increase the darkening effect of X-rays, Schmidt recommended a glass composition of high silica content for the use of X-ray tubes. He observes that borate glasses became gray under X-ray irradiation.

R. Schmidt could not find any clear relationship between the atomic weight or atomic number of an element and its photochemical behavior.

V. Čtyroky[22], as well as A. E. Badger and A. C. Ottoson[23], later confirmed Schmidt's findings that additions of certain amounts of Ce_2O_3 or FeO minimize X-ray discoloration.

F. Eckert and K. Schmidt[24] also studied the influence of cerium and arsenic on the photochemical behavior of silicate glasses. They found that these glasses turned brown under irradiation by either ultraviolet or X-rays, especially in the presence of iron or manganese.

J. Hoffmann issued a large number of papers on the discoloration of glasses by beta and gamma rays. In his earlier publications[25] he reported that sodium, potassium, and barium caused a brown color; manganese, blue to purple discoloration; and lead, a reddish color, accompanied by fluorescence. He ascribed such discoloration to the formation of metal atoms and thought that the shade was determined by the ratio of the metal oxide to the acid. He reported that the blue or purple color of the manganese did not appear if the iron content of the glass exceeded a certain limit and that then a gray discoloration resulted. The purple discoloration of a manganese-free sodium silicate was attributed to traces of platinum from the crucible in which the glass had been melted. Most borate glasses turned yellow to brown under irradiation by beta and gamma rays. Glasses solarized by ultraviolet were regenerated by beta and gamma rays.

In his later publications[26], Hoffmann developed a theory whereby the discoloration of silicate glasses under X-ray irradiation was due to the destruction of the SiO_4 tetrahedra in the network, which gradually lost one oxygen after the other, until the resulting silicon reacted with water to form silica and hydrogen. He developed similar theories for the formation of boron atoms from

borate glasses and of phosphor atoms from phosphate glasses. Removal of the discoloration by heating was attributed to oxidation of these atoms.

In a study of the photochemical effects of beta and gamma rays on glasses containing manganese[27], Hoffmann reports that all rays from the visible blue-violet to the shortest waves known discolor MnO-containing glasses, first red by oxidation to Mn_2O_3, then blue by partial reduction of this oxide to Mn_3O_4. He believes that Mn_2O_3 does not change into Mn_3O_4 in the presence of FeO. Hoffmann does not offer any convincing proof for any of his theories.

In another experiment, Hoffmann[28] exposed an ultraviolet-transmitting glass which consisted mainly of alkaline earth phosphates to soft X-rays. This glass turned pink. He also irradiated different metaphosphates with beta and gamma rays. All turned red, regardless of whether they were salts or glasses. Similarly, all pyrophosphates became purple, but alkali pyrophosphates had a pinkish tinge, alkaline earth pyrophosphates a bluish tinge. The latter required a longer irradiation time. Magnesium aluminum phosphate became orange after several days' exposure to beta and gamma rays, but changed to cherry red after 14 days. Barium phosphate first assumed a pink color, but it also turned cherry red after 8 to 14 days of beta and gamma irradiation.

D. H. Kabakjian[29] incidentally observed the effect of radiation from radium sulfate on Pyrex glass, when he studied the influence of these, rays on phosphorescent materials on a glass slide.

H. Kersten and C. H. Dwight[30] investigated the solarization of glass by soft X-rays. They found that the wavelengths of 1.54 and 1.38 A.U. were the principally active ones. They observed an exponential decrease of the light transmission with exposure time. When the discolored glasses were heated, also their recovery from solorization followed a logarithmic formula.

Tests with a spectrophotometer indicated, however, that the increase of the transmission was more rapid for light of longer wavelengths. Kersten and Dwight compared the spectral regions of 6500, 5500, and 4600 A.U.

R. Livingston and C. E. Nurnberger[31] took quantitative measurements of the light transmission of Pyrex glass after exposure to hard X-rays. They derived the equation

$$\log \frac{Io}{I} = a\ (I\text{-}e^{-\beta t})$$

in which the coefficient a is proportional to the thickness of the glass and to the absorption coefficient for the particular wavelength, but is independent of the intensity of the radiation, while the coefficient β is directly proportional to the radiation intensity.

Livingston and Nurnberger found that of all nuclear radiation, gamma rays were best suited for making measurements because alpha rays penetrated only to a depth of 0.04 mm and beta showed a noticeably diminishing effect at a depth of 2.5 mm. A study of the spectral distribution of the light absorption of the discolored glass showed a homogeneous color for the investigated Pyrex glass. Measurements were taken after 10, 45, and 104 hours of exposure.

J. P. Buxareu and X. C. Cramp[32] reported, however, that they observed increasing absorption from red to violet, resulting in a reddish yellow discoloration of the glass which they studied.

W. J. Arner and D. E. Sharp[33] obtained spectral curves and data on the development of color in a borosilicate glass which was exposed to radioactive rays for a long period of time.

L. L. Sun and K. H. Sun[34] tabulated the mass absorption coefficient for X-rays and gamma rays for all important oxides which may occur in glasses. Only in the range from 0.01 to 0.1 A.U. do these coefficients show a continuous relationship to the atomic numbers. However, absorption edges occur above 0.1 A.U.; pair production, photoelectric effect and Compton effect influence the absorption of rays below 0.01 A.U. The mass absorption coefficient of a glass can be calculated from the weight percentages of its constituents and their mass absorption coefficients.

When light of the entensity Io passes through a glass of the thickness t, the density ρ and the mass absorption coefficient ω, its final intensity I is given by the equation $I = Io\ e^{-\omega\rho t}$. This formula shows that the density of a glass and its mass absorption coefficient are of equal importance for its absorption of incident radiation. The oxides of heavy metals, like Ba, Ta, W, Pb, Bi, and Th, are, therefore, best suited for the production of X-ray absorbing glasses, while the oxides of light metals, like Li, Na, and Be, are preferred for the manufacture of X-ray transmitting glasses. A high percentage of silicic acid and particularly boric acid will, for the same reason, reduce the absorption of X-rays. Among the heavy metal oxides, those with the lowest oxygen content, like PbO and BaO, are the best X-ray absorbers.

J. J. Rothermel, K. H. Sun, and A. Silverman[35] developed a lead phosphate glass with a high absorption coefficient for X- and gamma rays, which does not discolor as fast under X-ray exposure as the lead silicate glasses commonly used for windows of X-ray machines. The addition of tungstic acid to this phosphate glass increases its durability without lowering its absorption coefficient for the active radiation.

K. H. Sun and L. L. Sun[36] described a cadmium borate glass with a particularly high absorption coefficient for neutrons, which, like cadmium metal, can be used for the shielding of personnel from neutron radiation. L. M. Melnick, H. W. Safford, K. H. Sun, and A. Silverman[37] improved the chemical stability of this cadmium borate glass by the addition of silica.

Glasses which show a minimum of discoloration under cathode-ray bombardment were developed for use in the face plates of television picture tubes.

The Corning Glass Works developed a group of photosensitive glasses for photographic purposes. They are copper, silver and gold ruby glasses which can also be made opaque by the addition of barium, strontium, or zinc fluoride. They contain cerium as an optical sensitizer. The striking temperature of these ruby glasses can be lowered if they are first exposed to ultraviolet radiation. Different colors may be produced by varying the glass composition and the irradiation time. S. D. Stookey[38], who developed some of these glasses, reports that beta rays and X-rays have similar effects on these glasses as ultraviolet radiation. Stookey believes that copper, silver, and gold originally dissolve as oxides and that irradiation causes their photo-reduction to the metallic form in which they are present in the ruby glasses.

W. A. Weyl's paper "On The Fluorescence and Photochemistry of Glass"[39] deals mainly with the influence of ultraviolet radiation. It mentions, however, that cathode-ray bombardment causes green fluorescence in lead glass and that high-speed electrons even produce phosphorescence. The light emission occurs when the excited electrons return to their original state.

In the investigation "On the Fluorescence of Atomic Silver in Glasses and Crystals", W. A. Weyl, J. H. Schulman, R. J. Ginther, and L. W. Evans[40] studied the fluorescence of silver-containing phosphate glasses under the influence of cathode-rays and X-rays. Electron bombardment reduces silver ions to atomic silver. Due to the low penetrating power of the cathode-rays, however, only the silver ions which were close to the glass surface could be reduced by this radiation. The employment of the deeper reaching X-rays, which liberated electrons also in the interior of the glass structure, allowed a more extensive reduction of the silver ions. This process could, of course, be carried out at room temperature, when the glass structure was quite rigid. By this skillful prevention of an aggregation of the silver atoms, the silver was retained in the glass in atomic distribution. Even before reduction, these glasses showed a weak blue fluorescence under exposure to ultraviolet light of 2537 A.U., but they did not fluoresce in ultraviolet light of 3650 A.U. After irradiation with beta or X-rays, the weak blue fluorescence was still observed with 2537 A.U. rays, but, in addition, an intense orange to yellow fluorescence appeared under 3650 A.U. excitation.

Further experiments have recently been carried out by Dr. W. A. Weyl and the author at The Pennsylvania State College. A variety of glasses were exposed to X-ray and to gamma rays.

Glasses which solarize under the influence of the ultraviolet radiation from the sun can be expected to change their color under high-energy radiation only if their absorption coefficient for these rays is sufficiently great. The most rapid solarization phenomenon known is the purple discoloration of silicate glasses which contain small amounts of cerium and vanadium. W. A. Weyl, A. G. Pincus, and A. E. Badger[41] have found that this color change is due to the photochemical reduction of the green V^{3+} to the purple V^{2+} ion by the ultraviolet rays. No appreciable color change was, however, observed when such glasses were exposed to X- or gamma rays.

Defective structures like rutile are known to discolor under the influence of sunlight. W. A. Weyl and T. Forland[42] explained this photochemical reaction on the basis of crystal chemistry and defect structures. They attributed this color effect to traces of Fe^{3+}, Cb^{5+}, W^{6+}, or other impurities in rutile. These impurity ions have a different charge than the Ti^{4+} ion and, therefore, produce asymmetrical force fields in the rutile structure. The strong polarization effects which are their result lead to surprisingly strong light absorption in titania containing only minute amounts of iron. Experiments with X-rays proved that this radiation has a similar, but decidedly smaller effect on titania-containing glasses.

The polarizing effect on an asymmetrical force field on the comparatively easily deformed O^{2-} ion could be studied when potassium barium silicate and borosilicate glasses darkened under the influence of X-rays. In the network of these glasses, the O^{2-} ions are placed between the small and highly charged Si^{4+} and B^{3+} and the large and weakly K^{+} and Ba^{2+} ions.

Considering that the sulfide ion is even more polarizable than the oxygen ion, various amounts of sulfide were incorporated into silicate glasses. The color change which X-rays produce in a silicate glass containing zinc sulfide is quite noticeable. The additional polarizability of the zinc ion may contribute to this effect. An even greater sensitivity to X-rays and also to gamma rays was observed in a sulfur-containing borate glass.

At the present time there is much interest in the effects of high-energy radiation of glasses and other materials. The extensive research which is now going on in this field can be expected to aid in the clarification of those phenomena which so far have not been fully explained.

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AMERICAN OPTICAL NINE-MONTH REPORT

American Optical Company's sales for the nine months ended September 30 were $49,536,471, compared with $42,270,734 for the corresponding 1950 sales, according to the recent report issued by W. A. Stewart, President.

The report showed net earnings of $1,859,589, or $2.86 a share, for the nine months in 1951, compared with $1,566,066, or $2.42 a share, for the same period in 1950.

CONFERENCE ON GLASS PROBLEMS AT URBANA

The 12th annual Conference on Glass Problems was held at the University of Illinois December 6 and 7, under the direction of Dr. F. V. Tooley. The selection of papers covered subjects of timely interest, and dealt with problems that affect all glass manufacturing companies. The application of improved quality control methods and time studies to production was discussed with the object of strengthening organization in advance of critical shortages of both materials and manpower. Of equal importance was the session devoted to training programs in which supervisor development was discussed in all its aspects. Certainly no program would be of more value at this time—as was evidenced by audience participation.

The first day's session of the Conference, which was presided over by Carl J. Uhrmann, Imperial Glass Company, was devoted to problems and developments in hand glass plants, with particular emphasis on quality control, time studies, and production problems.

Stating that the dollar sign is the objective of quality control, Nevin Cort, Bryer Bros. Company, discussed applications to shop losses, breakage in lehrs, and the over-all advantages of this program to the organization.

Application to lehr breakage involves keeping a control chart on each shop, as well as breakage charts. Study of variations in weight and distribution, case histories, and mold equipment resulted in better mold design, and in bettter control of other contributing factors. The pay-off was a 2% increase in savings, a reduction in costs, a reduction in losses, improvement of methods, and an improvement in quality.

The second discussion of the Conference involved an application of time studies that lowered labor and other costs, improved production, improved morale, and provided a proper yardstick for arriving at equitable earnings. As the result of this program, production increased by 80% to 120%, and better manufacturing conditions resulted in less dissatisfaction, together with a retaining of employees. Carl Yeater, of Fostoria Glass Company, ably handled this complicated subject, which included a discussion of incentives, bonus plans, and "bottlenecks."

Fatigue factors were considered and allowances were provided in "work" tables from which costs were derived. Installation of counters on lehrs provided more accurate accounting of pieces made. Selection losses were standardized for each job and mold cleaning practices were improved.

Merit ratings for individual differences among employees, those not measured by time studies, were applied by assigning a "weight" to such factors as quantity of work, quality of work, attendance and punctuality, cooperativeness, dependability, initiative, and versatility. This rating is reviewed every three months, and a chart is given to each employee.

In the organizational structure under consideration, 83% of the employees are on a bonus system based on direct measurements, 6% are on the merit rating plan briefed above, and 11% are on day work. Percent performance and premiums are posted each month as an incentive towards further improvement.

The continuation of the program on hand-glass operations included a discussion of control problems in the manufacture of colored glassware. C. E. Leberknight, Kopp Glass Company, pointed out that the demand for colored glass is on the increase, and explained by means of diagrams and charts the control problems associated with making both green and red signal glass. Limit glasses are used in the manufacture of green glass, and in both cases the glasses must meet rather definite standards based on light transmission measurements.

Alex C. Ottoson, Imperial Glass Company, reviewed the problems in hand plants and suggested areas of improvement. High quality tableware requires low iron-bearing materials, and a low iron oxide content glass. This problem is so important that it was suggested that only one chemical laboratory be used for analytical purposes, thus avoiding misinterpretation of analytical data.

Refractories were pointed out as being a constant source of contamination. The need for improved pots was stressed, as well as the desirability of arching to the stage of minimum shrinkage. During the panel discussion that followed, warming-up schedules were discussed; also the merits and disadvantages of existing types of pots. It was concluded that the present outlook for good pots is "dim."

Harold Baque and A. Williams

Fay V. Tooley and J. Sitzler

G. E. Reinker and R. C. Barker

Ralph K. Day, Axel Ottoson, and Carl J. Uhrmann

Mr. Ottoson also discussed combustion control as an influential factor, the importance of crushing cullet to size, moistening the batch, and the influence of certain batch ingredients on pots. It was suggested that barium nitrate be used in place of sodium nitrate so as to minimize pot corrosion. Strontium sulphate in amounts of 5 pounds per 400 pounds of sand gave very clear glass, but the attack on refractories was severe.

The second section of the Conference, with A. K. Lyle as Chairman, dealt with batch handling and feeding, with particular emphasis on the operation of continuous tanks, where operations are of sufficient magnitude to warrant adequate equipment.

The selection of weighing equipment was discussed by F. W. Gilchrist, of the Toledo Scale Company, who pointed out that the inherent accuracy of glasshouse scales is 0.1% of the rated capacity. The importance of rigidly insisting on a sequence of weighing operations was stressed, as well as a maintenance schedule. Setting up of a definite pattern is very important inasmuch as the accuracy of weighing is still a matter of the human element, namely the operator. Provision should be made for compensating for the raw materials in suspension which requires "presetting," a matter that involves two speed controls. It was pointed out that in this respect the accuracy depends on the consistency of the amount of material in suspension.

Mr. Gilchrest pointed out that flexible connections should be kept down to a minimum as they are sources of error, and reduce the accuracy of weighing. Major features of batch weighing equipment were discussed, together with precaution, such as the use of pilot lights in cycling, and the disadvantages of manual operation.

A. K. Lyle discussed the extent to which batch charging affects the homogenizing of glass in continuous tanks. Starting with the assumption that all other operations were perfect, Mr. Lyle presented sketches showing the flow of glass in tanks of different types, and the extent to which flow lines affect the quality of the glass.

Flow is caused by differences in density, and factors such as temperature differences, batch materials, and bubbles play a very influential part in promoting flow, although some of these factors are unfavorable under certain conditions. Vertical flow characterizes electric melting when the heat is at the bottom, and a "pulley and belt" type of flow exists in most other types of tanks. The extent to which adding batch in the form of lumps, which are actually rafts with their own convection currents, contributes to uniformity was pointed out. In contrast, a thick layer of batch tends to promote separation, with the last ingredient to melt being sand, which results in a silica residue, and the formation of cords.

Although convection currents are normally slow, they are necessary for homogenizing the glass. Inasmuch as the best source of flow is in the melting of raw materials, it is important that the materials be kept well mixed, and charged correctly into the doghouse, at which area conditions are the most favorable for producing uniformity.

(*Continued on page* 48)

P. Branham, H. Hicks, W. Pittman, and A. Nichols

J. K. Hamilton and H. J. Stephton

Inventions and Inventors

Annealing and Tempering

Lens Hardening Apparatus. Fig. 1. Patent No. 2,577,611. Filed Jan. 2, 1947. Issued Dec. 4, 1951. Four sheets of drawings. Assigned to American Optical Company by J. R. Eves.

This is a device for automatically postioning lenses for a heating treatment, controlling the heating time, and applying a cooling blast to temper the article. The base 11 contains a motor-driven blower 16 connected to nozzles 19 which at times deliver a blast of air against the opposite sides of the lens. The lens 20 is held by a pair of clamp members movable vertically between a furnace 49 and the cooling nozzles 19. Timing devices are provided, one being shown at 69, which determine the heating time. After the proper interval, the lens is lowered and the blower 16 is started. The opening to the furnace is closed by a door 95.

The operator sets the controls in accordance with the thickness of the lens and this actuates electrical connections to raise the lens to the furnace, lower it at the predetermined time, and subject it to the cooling blast. After setting, all operations are automatic.

The patent contains nine claims and the references cited were 233,672, Haley, Oct. 26, 1880; 1,776,823, Summey, Sept. 30, 1930; 2,166,348, Ford, July 18, 1939; and 2,409,284, Jackson, Oct. 15, 1946.

Feeding and Forming

Blowing Machine. Fig. 2. Patent No. 2,576,191. Filed Oct. 15, 1946. Issued Nov. 27, 1951. 12 sheets of drawings. Assigned to Corning Glass Works by Leander N. Pond.

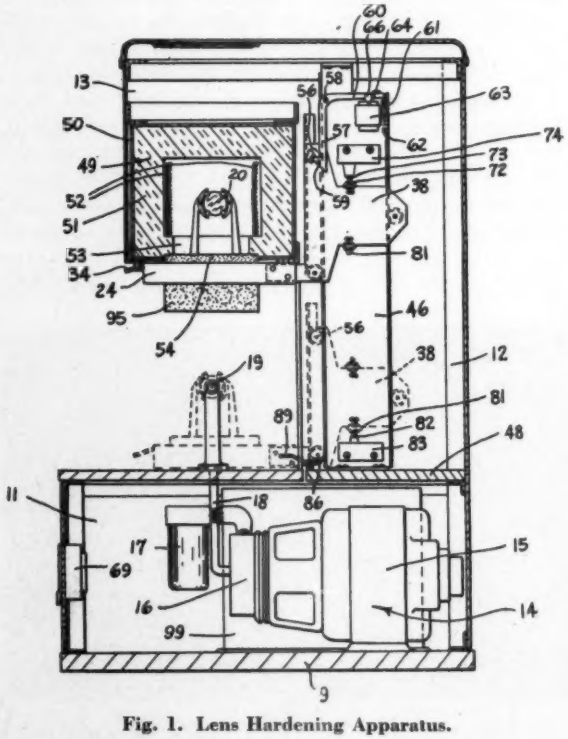


Fig. 1. Lens Hardening Apparatus.

This is a machine for making bottles, lamp bulbs, tumblers, etc. A charge of glass from a feeder is severed by shears 207 and 208 and is caught between a pair of parison forming members carried by the assembly 200. These swing the parison over and deposit it on an orifice plate 61 which is then pushed onto a blowhead carried by a turret. As the turret turns, the parison is first given a puff blow, then a mold closes about the parison, and it is blown to final form.

The orifice plate is then moved to an outer turret 14 which carries the ware to the crack-off mechanism where the ware is broken away from the cullet on the top of the orifice plate. The cullet is ejected into the cullet chute and the orifice plate is then ready to receive another parison.

The patent contains 15 claims and the references cited were: 962,519, Nicholls, June 28, 1910; 2,032,075, Weber, Feb. 25, 1936; 2,251,010, Allen, July 29, 1941; 2,263,126, Gray et al., Nov. 18, 1941; 2,357,501, Carnahan, Sept. 5, 1944; 2,391,963, Gray, Jan. 1, 1946; and 2,405,557, Bonnefoy-Cudraz, Aug. 13, 1946.

Glass Compositions

Optical Glass. Patent No. 2,576,521. Filed May 15, 1950. Issued Nov. 27, 1951. No drawings. Assigned to Bausch & Lomb Optical Company by N. J. Kreidl and G. F. Brewster.

This is a barium crown glass, such as is used in multifocal lenses, having high chemical durability. Three examples of such batches are given in weight percentages, as follows:

	I	II	III
SiO_2	30.12	31.72	31.01
BaO	37.28	37.68	38.38
ZnO	2.75	2.90	2.83
B_2O_3	6.76	7.16	6.96
Al_2O_3	1.11	1.17	1.14
Li_2O	2.87	3.04	2.95
Na_2O	1.62	1.71	1.67
La_2O_3	3.55	1.87	3.66
ZrO_2	6.72	7.07	6.92
Ta_2O_5	7.22	3.80	....
TiO_2	....	1.88	....
Nb_2O_5	....	....	4.48
	100.00	100.00	100.00
nD	1.667	1.665	1.663
ν	50.0	48.7	50.7

The patent contains four claims and the only reference cited was Kreidl, No. 2,518,028, dated Aug. 8, 1950.

Frit Composition for Vitreous Enamels. Patent No. 2,576,916. Filed Aug. 10, 1950. Issued Dec. 4, 1951. No drawings. Assigned to National Lead Company by M. D. Beals and L. R. Blair.

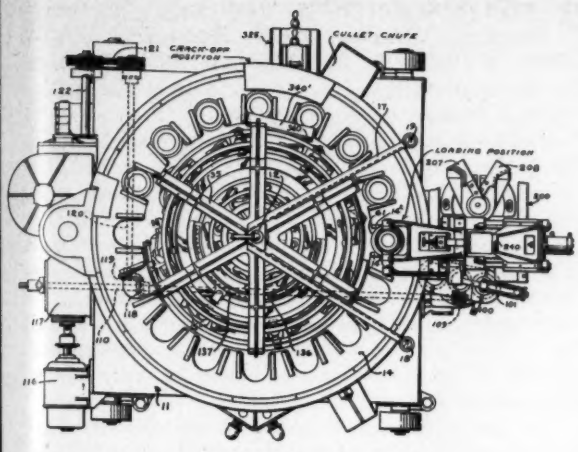


Fig. 2. Blowing Machine.

This patent contains two claims, the second claim being as follows: A frit composition capable of forming a vitreous enamel which matures at temperatures between 650° C. and 725° C. which comprises from 6% to 12% TiO_2, 18% to 37% P_2O_5, 19% to 36% Al_2O_3, 11% to 33% B_2O_3, 18% to 23% alkali metal oxide; the sum of the alkali metal oxide and the P_2O_5 equal to 62% to 83% of the sum of the alkali metal oxide, the P_2O_5 and B_2O_3; when the B_2O_3 is less than 22%, the Al_2O_3 must be at least 23%; when the B_2O_3 is at least 22%, the P_2O_5 must be less than 31%; the alkali metal oxide selected from the group consisting of Na_2O and Na_2O in combination with K_2O and Li_2O; the K_2O in amount to replace up to 30% of the Na_2O; the Li_2O in amount to replace up to 20% of the Na_2O.

The patent gives full information for the manufacture and use of the composition. No references were cited.

Acid-Resistant Glass. Patent No. 2,577,627. Filed May 1, 1947. Issued Dec. 4, 1951. No drawings. Assigned to American Optical Company by Alexis G. Pincus.

This glass is particularly resistant to attack by hydrofluoric acid, anhydrous hydrogen fluoride, and fluorides in general. It has certain advantages over the glass described in Patent No. 2,381,925. Three examples of the new glass are given, as follows:

Ingredient	Range of Parts by weight	Parts by Weight Specific Examples A	B	C
Phosphorus Pentoxide (P_2O_5)	72-85	77	77	75
Aluminum Oxide (Al_2O_3)	5- 9	8	8	7
Boric Oxide (B_2O_3)	1- 8	5	5	5
Bivalent Oxides (RO)	1-12	10		
		100		
such as:				
Zinc Oxide (ZnO)	.....	..	5	2
Magnesium Oxide (MgO)	.....	..	5	3
Beryllium Oxide (BeO)	.....	..	0	0
Calcium Oxide (CaO)	.....	..	0	3.8
Optional Ingredients				
Fluorine	0- 5	..	0	3.2
Alkali Oxides	0- 1 Na_2O or Li_2O		0.1	0.5
			100.1	99.5

The patent contains ten claims and the references cited were 1,961,603, Berger, June 5, 1934; 2,077,481, Huppert et al., Apr. 20, 1937; 2,294,844, Gelstharp, Sept. 1, 1942; and 2,423,128, Tillyer, July 1, 1947.

Oxyfluoride Glass. Patent No. 2,578,325. Filed Dec. 13, 1949. Issued Dec. 11, 1951. One sheet of diagrams, none reproduced. Assigned to Eastman Kodak Company by Kuan-Han Sun.

The optical glass of this patent is a continuation in part of Patent No. 2,511,224. The patent gives 11 examples of compositions coming under this patent, of which only the first three are given below. The compositions are given on the basis of anhydrous compo-

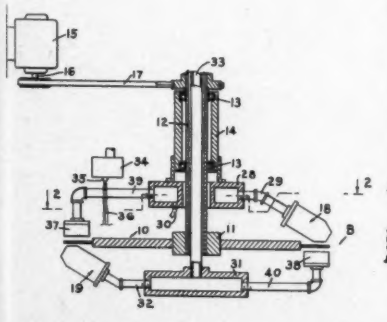


Fig. 3. Manufacture of Glass Fibers.

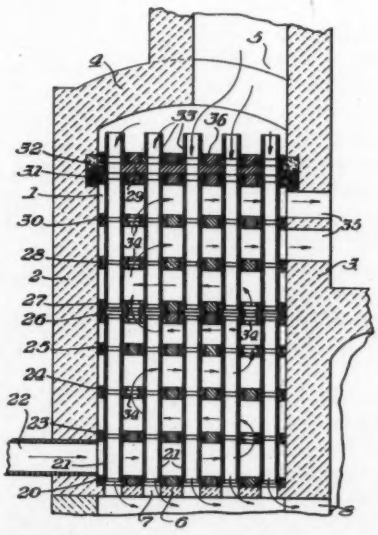


Fig. 4. Recuperator Structure.

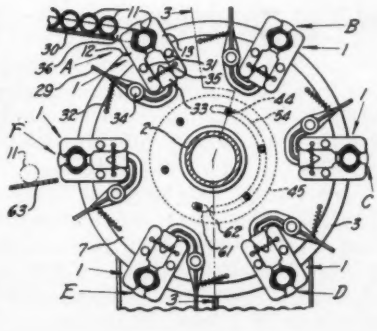


Fig. 5. Sealing-in Machine.

nents of the batch. The weight percentages are given under "W" and the mole percentages under "M."

	1		2		3	
	W	M	W	M	W	M
MgF_2	9.2	12.5	8.7	12.2	8.1	12.3
CaF_2	11.0	12.0	10.5	11.7	9.7	11.7
SrF_2	7.3	4.9	7.0	4.9	6.5	4.9
BaF2	8.2	4.0	7.9	3.9	7.3	4.0
PbF_2	9.2	3.1	10.5	3.8	9.7	3.7
LaF_3	8.2	3.6	7.9	3.5	7.3	3.5
AlF_3	15.5	15.7	15.7	16.4	14.5	16.5
BeF_2	22.9	41.5	21.6	40.3	18.3	36.9
$Al(PO_3)_3$	8.5	2.7	10.0	3.3	18.2	6.5
n_D	1.4183		1.4222		1.4321	

The patent contains six claims and no references were cited.

Glass Wool and Fiber

Manufacture of Glass Fibers. Fig. 3. Patent No. 2,577,204. Filed Jan. 11, 1949. Issued Dec. 4, 1951. Two sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by George S. McElroy.

A rotor 10 driven by a motor 15 and a series of high velocity burners 18 and 19 discharge a blast toward the periphery of the rotor from the top and the bottom. A stream of molten glass 36 is discharged from a tank 34 onto the rotating disc which is heated above and below by radiant-type burners 37 and 38. These are positioned between the burners 18 and 19 and serve to keep the glass on the rotor in a fluent condition. The blast from the burners heats and draws out the glass fibers after they have passed beyond the action of centrifugual force. The lower burners 19 also support the fibers and prevent them from falling. Some modifications and further details are found in the patent.

The patent contains 11 claims and the references cited were 2,238,204, Woods, Apr. 15, 1941; 2,450,363, Slayter et al., Sept. 28, 1948; 215,101, Switzerland, Sept. 1, 1941; and 72,087, Norway, May 12, 1947.

Tube and Cane Machines

Tube Cutting Machine. Patent No. 2,577,486. Filed April 4, 1949. Issued Dec. 4, 1951. One sheet of drawings, none reproduced. Assigned to Toledo Engineering Company by Franz G. Schwalbe.

This is a machine for feeding tube or cane to a cutting or marking device by which uniform lengths are cut or marked. The tube is fed from a drawing machine onto an endless conveyor and the cutter travels with the tube during the cutting operation. The main feature of the invention resides in the use of a supporting roller for the flexible conveyor, this roller being supported through the agency of a rubber air bag which may be formed from a pneumatic tire tube. This provides a yielding support for the work.

Reference is made to Patent No. 2,447,962 dated Aug. 24, 1948. The patent contains three claims and the references cited were 1,807,619, Boush, June 2, 1931; 2,007,910, Stephens, July 9, 1935; 2,157,067, Brown, May 2, 1939; 2,438,068, Mercier, Mar. 16, 1948; 2,447,962, Schwalbe, Aug. 24, 1948; and 2,497,586, Coons, Feb. 14, 1950.

Miscellaneous Processes

Recuperator Structure. Fig. 4. Patent No. 2,574,738. Filed Feb. 26, 1949. Issued Nov. 13, 1951. One sheet of drawings. Assigned to Amsler Morton Corporation by F. H. Graham and E. G. Smith.

The horizontal courses of this structure may be made up of four different kinds of title as shown in Patent No. 2,092,402. The hot gas follows the path shown by the arrows, entering at 5 and passing down through tubes 33, then to the stack through the passageway 8. The air to be heated enters through the pipe 22, thence upwardly around the outside of the tubes, and to the furnace by ports 35. This makes a structure which is easily repaired. When fused dust accumulates around the tops of the tubes 33, the parts may be easily cleaned or replaced.

The patent contains four claims and the references cited were 1,124,593, Cooper, Jan. 12, 1915; 2,092,402, Morton et al., Sept. 7, 1937; and 2,132,150, Fenske, Oct. 4, 1938.

Transfer for Bottles. Patent No. 2,575,220. Filed June 19, 1948. Issued Nov. 13, 1951. Five sheets of drawings, none reproduced. Assigned to Emhart Manufacturing Company by E. O. Hiller.

This is a device by which a carton of bottles, placed on a table, are fed out in a single row for the next operation, such as filling. A tilting shelf is provided so that the carton can be turned bottom up, depositing the bottles in rows between guides which prevent the bottles from tipping over. From this table the bottles are pushed onto a transverse conveyor which takes them to the next machine. A modification is shown for handling non-circular bottles.

The patent contains 18 claims and the references cited were 724,240, Baker, Mar. 31, 1903; 1,092,609, Taliaferro, April 7, 1914; 1,352,607, Jones, Sept. 14, 1920; 1,476,023, Phelps, Dec. 4, 1923; and 1,612,215, Phelps, Dec. 28, 1926.

Sealing-in Machine. Fig. 5. Patent No. 2,575,746. Filed Jan. 11, 1947. Issued Nov. 20, 1951. Two sheets of drawings. Assigned to General Electric Company by Paul O. Cartun.

This machine is for sealing-in at the same time both ends of a relatively long tubular lamp envelope. The machine is of the turret type having six heads mounted on a horizontal axis into which the tubes 11 are introduced at station A. At each end of the tubes there is a head and tail stock which travels with the tube carrier and which carries the electrode mounts for the ends of the tube. At station B the mounts are moved into engagement with the ends of the tube which have been previously heated. At stations C, D, and E, the heating of the parts continues and at station F the lamp is released and removed by the operator.

The patent contains 14 claims and the references cited were 1,011,523, Swan, Dec. 12, 1911; 1,461,155, Madden et al., July 10, 1923; 2,121,627, Donovan et al., June 21, 1938; 2,212,842, McGowan, Aug. 27, 1940; 2,364,673, Stuckert et al., Dec. 12, 1944; 2,394,115, Snyder, Feb. 5, 1945; 2,417,361, Herzog, Mar. 11, 1947; 2,434,664, Malloy, Jan. 20, 1948; 2,455,317, Schneider, Nov. 30, 1948; and 542,173, Germany, Jan. 22, 1932.

Glass Batch. Patent No. 2,578,110. Filed Oct. 14,

1944. Issued Dec. 11, 1951. One sheet of drawings, none reproduced. Assigned to Owens-Corning Fiberglas Corporation by Fay V. Tooley.

This process is of particular use in the manufacture of glass fibers. The various batch ingredients are either processed or so selected that at least the most difficult melted materials, such as silica, are of a small particle size; for instance, will pass through a screen having in the neighborhood of 325 or more meshes per inch. The batch ingredients in the desired proportions are then thoroughly mixed to a substantially homogeneous mass and are then fixed in this homogeneous condition by briquetting. Gas is removed from the briquettes by a heat treatment.

It is of advantage to have the briquettes of small size; perhaps less than one-half inch is the largest diameter. If these briquettes are made in accordance with the directions in the patent and fed onto the molten glass in a thin layer, a seed-free glass may be melted very rapidly.

The patent contains two claims and the references cited were 1,149,451, Kann, Aug. 10, 1915; 1,543,770, Hilbert, June 30, 1925; 1,995,803, Gilbert, Mar. 26, 1935; 2,114,545, Slayter, Apr. 19, 1938; 2,214,191, Batchell et al., Sept. 10, 1940; 2,220,750, Bair et al., Nov. 5, 1940; 2,230,343, Blair, Feb. 4, 1941; 2,366,473, Jan. 2, 1945; and Ceramic Abstracts, complied by American Ceramic Society, Columbus, Ohio. Vol. 21, page 211, October 1942, abstract entitled "Mixing of Batches and Briquetting in the Glass Industry."

High Frequency Sealing Fixture. Patent No. 2,572,646. Filed May 23, 1947. Issued Oct. 23, 1951. Three sheets of drawings, none reproduced. Assigned to Bell Telephone Laboratories by P. R. Menzel and J. W. West.

This invention is for use in making glass-to-metal seals for electronic discharge devices in which a plurality of metal terminals are secured in a glass stem. A heating element of copper is so shaped that high frequency currents induced therein follow a path in which the heat is applied to the parts to be sealed in the most advantageous manner. This makes a seal without the need of highly skilled workmen and of superior quality.

The patent contains seven claims and 11 references were cited.

Sealing Cathode-ray Tubes. Patent No. 2,573,266. Filed Nov. 20, 1950. Issued Oct. 30, 1951. Two sheets of drawings, none reproduced. Assigned to The Rauland Corporation by Walter P. Melcher and Harry H. Voelz.

This invention is directed particularly to sealing a glass viewing plate of rectangular or other non-circular shape to the conical portion of a cathode-ray tube. A table supports the conical element with the large end up and the viewing plate resting in position. A cam shaped to correspond with the shape of the plate moves a series of burners so that heat is applied to the joint between the viewing plate and the top of the conical element while these parts are rotated. By proper shaping of the cam, the burners can be made to follow various shaped viewing plates.

The patent contains six claims and no references were cited.

Manufacture of Lamp Bases. Patent No. 2,573,365. Filed Oct. 4, 1947. Issued Oct. 30, 1951. Six sheets of drawings, none reproduced. Assigned to Sylvania Electric Products, Inc., by A. B. Scholes and Oliver Mann.

A lamp base comprises a threaded metal shell, a metal eyelet, and glass to insulate the parts. This invention proposes to press buttons automatically to form the glass insulating parts of the base. This is done on a turret type machine.

The patent has four claims and the references cited were 353,461, Otterson, Nov. 30, 1886; 696,254, Nash, Mar. 25, 1902; 1,770,335, Fuwa, July 8, 1930; 1,977,162, Wilcox, Oct. 16, 1934; 797,345, France, Apr. 24, 1936; and Ser. No. 423,106, Mickley (A. P. C.), published April 27, 1943.

SELENIUM AND FLUORSPAR PROPOSALS FOR HANDMADE GLASSWARE INDUSTRY

The National Production Authority has presented to the Handmade Stem, Table and Art Glassware Industry Advisory Committee a proposed system of allocating selenium and a proposal to limit the use of fluorspar in making handmade glass.

The committee endorsed both proposals, but asked that NPA give consideration to the seasonal demands of the trade in allocation of selenium. Members also asked that permitted inventories of fluorspar be large enough to enable manufacturers to buy economically in carload lots.

The selenium allocation proposal would require that glassmakers report their current monthly needs for the metal, their planned monthly glassmaking schedules, plus their use of selenium and sand in making glass during the first six months of 1950, which would represent a base period of selenium use per ton which they could not exceed. Allocations of the metal, which is a by-product of copper electrolytic processing, would be made monthly for use in decolorizing and coloring glass. For decolorizing glass, manufacturers would receive an amount based on current production in terms of sand to be melted. For coloring, they would receive a share of the total available supply based on current glassmaking production.

The proposed fluorspar restriction order would limit consumption of high-grade, or acid, fluorspar to 50 per cent of 1950 consumption. No usage restriction would be placed on ceramic grade fluorspar, but both grades would be limited to 45 days' inventory.

L-O-F RECEIVES EXCELLENCE CERTIFICATE

Libbey-Owens-Ford Glass Company has received the certificate of management excellence from the American Institute of Management, it has been announced by Jackon Martindell, President of the Institute, in a letter to John D. Biggers, President of L-O-F.

The Institute analyzed 3,000 companies as to economic function, corporate structure, health of earnings growth, fairness to stockholders, research and development, directorate analysis, fiscal policies, production efficiency, sales vigor and executive evaluation, and selected 298 in 112 different industries as meeting standards of excellence, according to Mr. Martindell's statement.

Investigation of the Adherence of Glass to Metals and Alloys

Dartnell, Fairbanks, and Koehler *(Journal of the American Ceramic Society,* November 1951) report the results of their investigations on the adherence of glass to metals and alloys, said investigations being confined to conditions which simulated those encountered by the mold equipment used on the automatic forming machines of the glass container industry.

The equipment used consisted essentially of that used in previously described researches on this subject and is composed of three main units: a glass feed mechanism, a heating assembly, and a photoelectric timing unit. The glass feed mechanism is used to feed a glass rod into a melting flame continuously in order to secure a uniform size molten glass bead. The glass rod is attached to an extension arm from the screw feed which slowly revolves and lowers the glass rod into the flame. The speed of the screw feed is such that one molten glass bead every minute is produced. The heating assembly was used in order to obtain a wide temperature range for the metal samples. It consists of a lower section which holds the cobalt alloy resistance wire and an upper section which shields the sides of the metal sample to prevent loss of heat by radiation. The photoelectric timing unit was used to measure the time of contact of the molten glass beads to the heated metal samples in increments of 1/120 of a second.

In this investigation, two kinds of glass were used. The first was an amber soda-lime glass and the second, a clear soda-lime glass having the compositions as shown below:

	Amber	Clear
SiO_2	71.3	67.7
Al_2O_3	2.5	....
Fe_2O_3	0.18	....
CaO	10.8	5.6
MgO	0.4	4.0
B_2O_3	0.8	1.5
Na_2O	13.4	15.1
K_2O	0.4	1.2
R_2O_3	....	2.8

The procedure used was to attach a glass rod to the screw mechanism and lower it into the flame which was regulated to produce molten glass beads having a temperature of 2200° ± 25°F. before parting from the rod (temperatures by optical pyrometer). These molten glass beads fell 2½ in. onto the surface of the prepared metal sample which was inclined at an angle of 45 degrees, the time of contact being measured by the means of the photoelectric timer. At the beginning of each test, the metal sample was heated 200°F. above the sticking temperature, as determined by the preliminary run, and held at that temperature for 15 minutes. The metal sample was allowed to cool slowly as molten glass beads were dropped on it at intervals of approximately 1 min. The time of adherence of each molten glass bead and the corresponding temperature of the sample were recorded and plotted. The adherence temperature was determined as the point at which the adherence curve deviated from the line of free fall. This indicates the maximum metal temperature at which the glass does not adhere to the metal.

Persistence tests were carried out as in the foregoing procedure with the modification that the temperature of the metal was held constant and molten glass beads were dropped on the metal surface until adherence occurred. The persistence was determined as the cumulative time between the time the first molten glass bead dropped on the heated metal surface and the first molten glass bead adhered to the heated metal surface.

A number of ferrous alloys, pure metals, and nonferrous alloys were investigated with respect to their adherence temperatures. It was found that tungsten and nickel of the pure metal group and Monel of the nonferrous alloy group had adherence temperatures above 1000°F. A carbon of electrode grade was tested and found to have an adherence temperature of 1145°F. In the case of cast iron, it was found that as the per cent carbon in the iron was increased, the adherence temperature decreased. The highest adherence temperature obtained for the iron carbon alloys was 920°F.

It was noted that a sample of brass from a used glass mold had an adherence temperature of 850°F. and that from an unused mold it had an adherence temperature of 900°F. Heat treating of a modified brass sample changed its structure from nodular to dendritic and lowered its adherence temperature from 900 to 850°F., thus confirming the difference noted in the used versus new brass molds.

The persistence test was made on tungsten, nickel, Monel, and K-Monel metals using both amber soda-lime glass and clear soda-lime glass.

The major factors which were considered to influence the adherence in the persistence tests were the type of metal used, structural changes in metal, kind of glass used, corrosion and erosion of metal surface. Upon microscopic examination no structural changes were noted in the metals tested for persistence. However, the surface of the metals had been definitely roughened at the place of contact of the molten glass beads. Also a deeper oxide stain was noted on the metal surface adjacent to the area of molten glass bead contact. This led to the conclusions that the additional heat from the glass aided the formation of oxides and that in the area of contact the glass bead absorbed the oxides.

A combination of corrosion and erosion was considered to have caused the roughening of the metal surface. The metal surface was, first, corroded by oxidation with air and, second, eroded by the absorption of the oxide film into the surface of the molten glass bead upon contact. The rough surface produced on the metal contained ridges and peaks which, upon contact with a molten glass bead, became heated to a higher temperature than normal, causing adherence.

The rate of corrosion and erosion was dependent upon the affinity of the molten glass and parent metal for the

(*Continued on page* 46)

Current Statistical Position of Glass

Employment and payrolls: During October 1951 employment in the glass industry fell off to a preliminary 129,000. Compared with the previous month's adjusted figure of 130,300, a drop of .009 per cent is shown. During October 1950 employment was 128,300, or .005 per cent below October 1951.

Payrolls during October also fell off and reached a preliminary $36,832,510. This is .009 per cent less than the adjusted payroll figure for September of $37,175,459. October 1950 payrolls were $36,315,743, which is 1.4 per cent less than October 1951.

Glass container production, based on figures released by the Bureau of Census, took a nose-dive during November 1951 to reach the lowest monthly figure during 1951—7,804,302 gross. During October production was 9,341,487 gross, which is 16.4 per cent more than for November. During November 1950 production was 9,441,331 gross, or 17.3 per cent higher than for November 1951. At the close of the January-November 1951 period, glass container manufacturers have produced a total of 100,747,929 gross. At the close of the same period in 1950, the production total was 97,132,767 gross, which is 3.7 per cent less than for 1951.

Hope for setting a new all-time high for one year's glass container shipments steadily waned with the continued downward trend of shipments. However, it is reasonably certain that a new second high will be established for the year of 1951. In November glass container manufacturers shipped 7,925,815 gross. Compared with the previous month's 9,186,101 gross, a drop of 12.6 per cent is shown. During November 1950 shipments were 8,325,876 gross, or 4.8 per cent higher than for November 1951. At the close of first eleven months of 1951, glass container shipments have reached a total of 106,967,342 gross. This total is 8.6 per cent ahead of the 98,431,081 gross shipped during the corresponding period in 1950.

Stocks on hand at the close of November 1951 remained at about the same level—9,709,581 gross. At the end of October stocks were 9,884,199 gross and at the end of November 1950, they were 7,063,678 gross.

Automatic tumbler production during November 1951 dropped 21.7 per cent to reach 3,889,334 dozens. This is a drop from October production of 4,965,560 dozens. During November 1950 production was 5,876,177 dozens. Shipments of automatic tumblers also continued to drop and were 4,645,353 dozens. This is 14.2 per cent less than the 5,414,286 dozens shipped during October. During November 1950 6,106,785 dozens were shipped. Stocks on hand were 11,228,354 dozens at the close of November 1951. This is 6.3 per cent less than the 11,977,793 dozens on hand at the close of October. At the close of November 1950, stocks were 9,592,759 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware during November 1951 were 3,368,398 dozens. This is 2.6 per cent below the 3,458,555 dozens sold during October. Sales during November 1950 were 3,312,712 dozens. At the close of the 12-month period ending November 1951, manufacturers have sold a total of 39,768,109 dozens. This is 2.4 per cent more than the 38,830,885 dozens sold during the same period ending November 1950.

GLASS CONTAINER SHIPMENTS

(All figures in Gross)

	November 1951
Narrow Neck Containers	
Foods	631,735
Medicinal & Health Supplies	959,319
Chemicals, Household & Industrial	552,948
Beverages, Returnable	305,115
Beverages, Non-returnable	14,056
Beer, Returnable	129,325
Beer, Non-returnable	710,367
Liquors	775,176
Wines	322,029
Toiletries & Cosmetics	446,324
Sub-total (Narrow)	4,846,394
Wide Mouth Containers	
Foods	*2,007,226
Dairy Products	260,366
Medicinal & Health Supplies	292,005
Chemicals, Household & Industrial	80,800
Toiletries & Cosmetics	112,588
Packers' Tumblers	114,356
Sub-total (Wide)	2,867,341
Total Domestic	7,713,735
Export Shipments	212,080
TOTAL SHIPMENTS	7,925,815

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All figures in Gross)

		Production November 1951	Stocks November 1951
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	2,714,393	3,598,160
	Wide Mouth	*2,349,816	*3,029,236
Dairy Products		254,957	308,675
Beverages, Returnable		382,576	581,965
Beverages, Non-returnable		16,662	20,815
Beer, Returnable		154,725	253,910
Beer, Non-returnable		639,640	513,898
Liquors		787,496	924,148
Wines		364,240	348,377
Packers' Tumblers		139,797	130,397
TOTAL		7,804,302	9,709,581

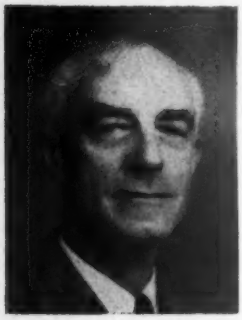
* This figure includes Home Canning.

PENNSALT SALES REORGANIZATION

The Pennsylvania Salt Manufacturing Company has announced the completion of a new organization of its Sales Division. The new organization, toward which the company has been moving for the past two years, is designed to consolidate sales administration while retaining specialization essential to the company's diversified interests, and at the same time provide more emphasis on planning for current and future sales activities.

DR. SAMUEL SCHOLES TO RECEIVE BLEININGER AWARD

Dr. Samuel R. Scholes, Professor of Glass Technology at New York State College of Ceramics and outstanding ceramist and educator, has been named the recipient of the Albert Victor Bleininger Award for 1951. The announcement was made at a meeting of the Pittsburgh Section of the American Ceramic Society by Donald E. Walsh, Chairman of the Section.



The Bleininger Award is presented annually in this country to an outstanding man in ceramics for "distinguished achievement in the field of ceramics." The medal and scroll, representing the award, will be presented to Dr. Scholes at a dinner to be held in the Hotel Schenley, Pittsburgh, on the evening of March 14, 1952.

Dr. Scholes has had an interesting career, the latter part of which has been devoted to teaching glass technology at the New York State College of Ceramics. Born in Marquette, Wisconsin, he received his A.B. degree at Ripon College, Ripon, Wisconsin. After an interim as a high school instructor from 1905 to 1908, he served as an assistant in chemistry at Yale from 1908 to 1910. He then became the Loomis Fellow and in 1911 received his Ph.D. degree in physical chemistry.

In 1911 Dr. Scholes was appointed the H. C. Frey Glass Company's Fellow at the Mellon Institute of Industrial Research, and in 1913 became the company's chemist, serving in that capacity until 1920. Dr. Scholes later became Assistant Director of Mellon Institute, then Superintendent of the Utility Glass Company, later moving to Federal Glass Company, where he remained until 1929 working on production problems. While at Federal Glass, he gave a series of lectures on glass in the Department of Ceramic Engineering at Ohio State University and advised on thesis work.

In 1929 Dr. Scholes joined the staff of Fostoria Glass Company as Technical Director and chemist, but returned to his former position with Federal Glass Company in 1931. He was then appointed in 1932 as Professor of Glass Technology at New York State College of Ceramics and still functions in that capacity. In addition to his professorship, Dr. Scholes is also Associate Dean of the College.

Dr. Scholes has been a member of many societies, including the American Chemical Society where he has served as an officer. He was named a Fellow of the Society of Glass Technology in 1940 and was admitted to the Fellowship of the American Association for the Advancement of Science in 1934. He has been a member of the American Society for Testing Materials since 1935 and has served as Secretary of Committee C-14 on Glass and Glass Products since 1944. He is also a member of the Society for Engineering Education.

Dr. Scholes has been a member of the American Ceramic Society since 1917. He is a Charter Fellow of the Society and served as Dean of the Fellows in 1939. He was Chairman of the Glass Division in 1920 and was Secretary of the Division from 1935 to 1948. He has published many technical papers and is author and editor of three books: Modern Glass Practice, Glass Tank Furnaces, and Handbook of the Glass Industry. Dr. Scholes is the fifth recipient of the Bleininger Award.

GLASS FIBERS EXPANSION

Glass Fibers, Inc. has purchased the controlling interest in the Vibradamp Corporation, with headquarters at Los Angeles and Santa Clara, California. This announcement was made by R. H. Barnard, President of Glass Fibers.

The newly acquired company utilizes a Glass Fibers' product, lightweight glass wool, in the manufacture and fabrication of specially-designed shock mounts, vibration mounts, and other products for defense weapons, in addition to many commercial applications. All are made under a patented process and sold under the trade name, "Vibraglass".

In making the announcement, Mr. Barnard said, "This new acquisition represents the initial culmination of our plan to become a real part of West Coast industry which is so vital to our national economy and preparedness program." He added that as soon as possible his company will offer West Coast customers, in addition to the already established "Vibraglass" items, the complete line of "Vitron" glass fiber products.

GLASS CONTAINER-NPA MEETING

Revocation of Order M-51, which controls the manufacture of glass containers and establishes simplified designs, would be acceptable, the Glass Container Industry Advisory Committee said at its recent meeting with the National Production Authority.

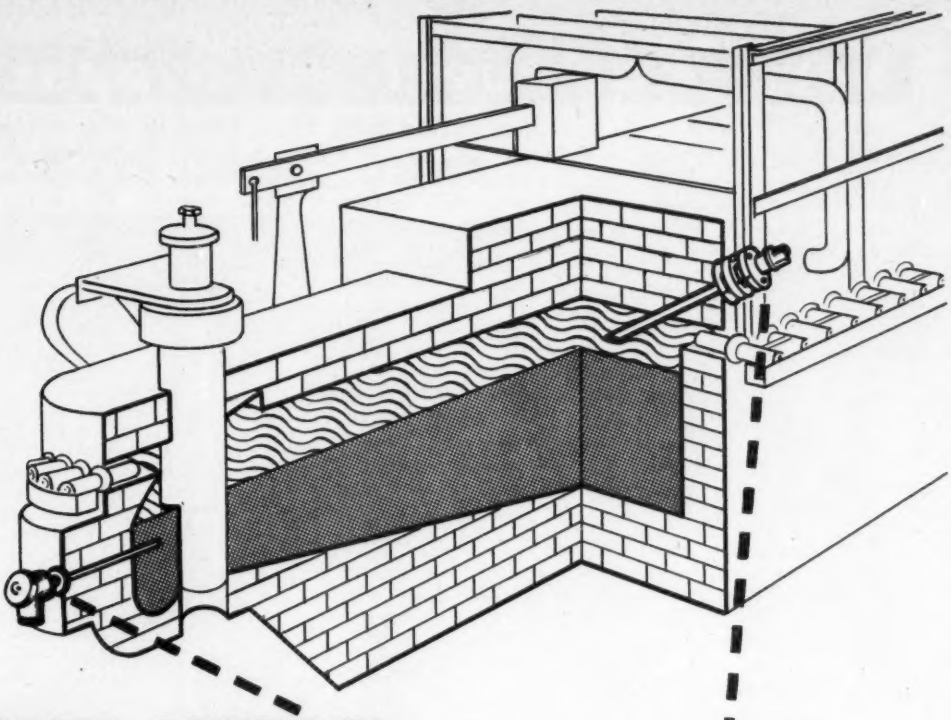
In keeping with its policy to continue only those orders which are deemed necessary to promote the defense program, NPA suggested that M-51 be revoked in view of the present balance of the supply and demand for glass containers and in view of forecasts of future production and demands. Therefore, they asked for the Committee's views on the suggested revocation of the order. NPA said the highest level of production in the history of the industry was reached during 1951 when the annual output rate based on the first eight months of the year was 126,000,000 gross glass containers. The Committee members estimated that the 1952 demand for glass containers would be approximatelly 105,000,000 gross.

NPA officials assured the Committee that reinstatement of M-51 would be an easy matter if the order was revoked and subsequently needed again if the annual demand for glass containers reached 120,000,000 or 125,000,000 gross. The Committee agreed that glass containers should remain subject to NPA Regulation 1 (inventory control) which, in part, limits users to a practicable minimum working inventory.

NEW STAUFFER LABORATORY

J. F. Crowther, Director of the Eastern Research Division of Stauffer Chemical Company, has announced the completion of a new laboratory adjacent to the Stauffer Plant at Chauncey, New York, where additional facilities for pilot plant work are maintained.

The new modern laboratory will be under the supervision of Dr. J. T. Bashour. It has 16 laboratory rooms and offices.



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- Holds gob temperature precisely at the optimum point for maximum machine speed.
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Instrument engineers will recognize that completely effective feeder temperature regulation requires a system operating as a function of how far (proportional action), how long (reset action), and how fast (rate action) temperature deviates from control setting. *Only L&N* offers you all three functions in either an electric or pneumatic control system.

To benefit from our engineering experience in this application, contact our nearest office, or write us at 4945 Stenton Ave., Phila. 44, Pa.

After a trial of Speedomax Electric Control, Brockway Glass Company decided to equip every feeder in all four of their plants. Note how control for a 2-zone feeder is all on one panel. Primary element in either zone can be Rayotube or thermocouple.

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New Equipment and Supplies

UNIVERSAL pH METER

North American Philips Company, Research and Control Instruments Division, 750 South Fulton Avenue, Mount Vernon, New York, has announced a new Philips Universal pH meter, precision built for reliable service and for quick, accurate measurements of hydrogen-ion concentrations. The new instrument is designed for all pH and rH work, for potentiometric titrations, and for oxidation-reduction-potential investigations.

For laboratory research and industrial testing purposes, it provides a measuring accuracy of 0.01 pH or 0.5 mv., a range of 0-14.15 pH and 0-1415 mv., absolutely currentless measuring with no phenomena of polarization, zero indication by cathode ray tube, can be used with glass, quinhydrone, hydrogen, and platina electrodes, and is directly calibrated for the first three.

NEW CO_2 RECORDER

The Hays Corporation, Michigan City, Indiana, has announced the development of a new CO_2 recorder designed for speed and accuracy in large industrial power plants and industrial stations.

Gas to be analyzed flows through a gas passage from which portion diffuses through a saturator (where it is saturated to a constant water vapor dilution at 130°F.) into measuring cell. As the gas comes into the cell, it conducts heat from the heated resistor proportional to its thermal conductivity. Heat conducted away from the resistor changes its electrical resistance.

Simultaneously, air (similarly saturated) diffuses from the air chamber into a comparison cell. Air conducts heat away from the heated resistor proportional to its thermal conductivity. This change in resistance is used as a constant reference. Change in resistance of the comparison cell resistor is compared with change in resistance of measuring cell resistor in bridge circuit of analyzer. The bridge circuit is connected into a network of recorders where resultant resistance measurement is amplified, indicated, and recorded.

MATERIAL HANDLING EQUIPMENT

Philips Mine & Mill Supply Company, 2347 Jane Street, Pittsburgh 3, Pa., has announced the addition of its Model T-SRF-½ Phil-Dump Trailer to its line of material handling equipment. This self-dumping unit, with its one-half cubic yard capacity, was designed for three-way use: pulling by hand, lifting and transporting by fork lift truck, and towing singly or in train by an industrial tractor.

Conveniently sized for handling by one man, this Phil-Dump features a sturdy tongue for manual and tractor handling. The design also includes pockets for accommodating the prongs of a fork lift truck. Balance of the hopper is such that when the safety catch is released, the load is emptied, after which the hopper automatically returns to the loading position, re-engaging the safety catch.

IMPROVED X-RAY DIFFRACTION SPECTROMETER

North American Philips Company, Research and Control Instruments Division, 750 South Fulton Avenue, Mount Vernon, New York, has announced the availability of its new, improved Norelco Geiger-counter recording X-ray spectrometer. The complete assembly consists of three components: basic X-ray diffraction unit, wide-range Geiger-counter goniometer, and electronic circuit panel with strip chart recorder.

The new instrument is used for X-ray powder diffraction work and fluorescence analysis and incorporates an X-ray optical arrangement which gives extremely high resolution.

The basic X-ray diffraction unit is designed to operate on 200-240 volts, A.C., 50 or 60 cycle, with full-wave rectification and facilities for visual indication of tube functioning. X-ray tube current is provided with stepless controls to give up to 60 KvP and 50 Ma, indicated on precision meters.

The wide-range Geiger-counter goniometer is designed to scan and analyze X-ray diffraction spectra of specimen materials by divergent-convergent beam-focusing angles from -38° to 180°, with useful X-ray diffraction range from 38° to 165°.

The electronic circuit panel includes Brown strip chart recorder, timer and clock panel, scaling and rate meter circuits, impluse counting and interpolation system, direct current Geiger-counter power supply, and a specially designed electronic over-all voltage stabilizer.

CATALOGS RECEIVED

The Hevi Duty Electric Company, Milwaukee 1, Wisconsin, has announced the publication of a new manual entitled "Maintenance Guide for Electric Heat Treating Furnaces."

The manual was written to guide management and operators in the maintenance and use of electric furnaces. A handy check sheet is included in the manual to simplify maintenance schedules, reduce breakdowns, and prolong furnace life.

Allied Chemical & Dye Corporation, General Chemical Division, Baker & Adamson Products, 40 Rector Street, New York 6, New York, is offering a new 264-page catalog of laboratory reagents and fine chemicals.

The catalog covers more than 1000 high purity chemicals, including such pertinent facts as grades, strengths, maximum limits of impurities, etc., on all reagents. Extremely useful to the laboratory chemist is a special section dealing with storage and handling chemicals that require extra care.

Another informative feature of interest to purchasing, operating, and laboratory personnel is a section on packaging. This contains photographs and full particulars on the major types of packages used by General Chemical for its B&A products in laboratory and bulk quantities.

Mississippi Glass Company, 88 Angelica Street, St. Louis 7, Missouri, has issued a new 16-page catalog designated as Number 52. To aid architects, engineers, contractors, decorators, and others in their selection, actual photographs, together with light distribution charts of each pattern, are presented.

Also included is technical information on Coolite, Heat Absorbing, and Glare Reducing Glass, as well as tables showing maximum sizes, thicknesses, and approximate weights on the company's complete line.

Ledeen Manufacturing Company, 1600 S. San Pedro Street, Los Angeles 15, California, has issued its Bulletin 152 calling attention to several industrially-proven installations of Ledeen cylinders in over a dozen different fields.

Following the bulletin's theme "Use a Cylinder and Save a Man", application of the cylinders is illustrated and described in such fields as chemical plants, oil refineries, lumber mills, etc.

Libbey-Owens-Ford Glass Company, Toledo, Ohio, has announced publication of a 1951 revised edition booklet devoted to Glass for Construction.

Specifications and descriptive material is included covering polished plate glass, Golden polished plate, mirrors of polished plate, Mirropane transparent mirrors, Tufflex, window glass, safety glass, bullet resisting glass, Thermopane, Vitrolite, bent glass, and decorated glass. The L-O-F Blue Ridge line is discussed with data on patterned glass, Aklo heat absorbing glass, wire glass, and Securit glass.

Minneapolis-Honeywell Regulator Company, Industrial Division, Philadelphia 44, Pa., has issued its Catalog 5000 consisting of 28 pages and describing the principal instruments, control devices, and related components manufactured by the company's division.

Specifications of approximately 100 measuring and control instruments and valves are outlined. Included are several new designs, including the Differential Controller and Tel-O-Set Controller Family.

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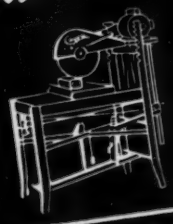

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THEN USE YOUR CLIPPER "4" WAYS

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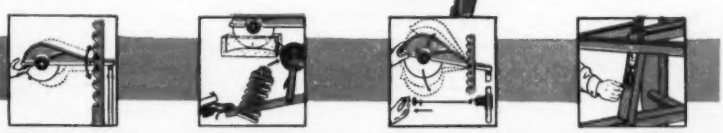
. . . at any time the cutting head of your Model HD Clipper Masonry Saw can be placed on the "CONVERTIBLE" CART (that's all you do)—you're then ready to saw concrete or asphalt patches or trenches! Imagine...switching from cutting glazed tile, concrete, face brick to sewer, water or gas lines or floor patches. No more fractures beyond removal lines—no more spalling!

But there's more . . . just set the "CONVERTIBLE" CART on Tracks and operate as a TRACK SAW. Stone slabs, Transite sheets, Plywood, Masonite, Pre-Cast Stone and large Refractories can at last be easily cut.

Try This Combination on FREE TRIAL

Order TODAY . . . on FREE TRIAL. Discover for yourself how Clipper will increase production . . . cut costs . . . increase profits. Only through the Clipper FREE TRIAL ARE you guaranteed . . . ACTUAL TEST on the JOB . . . FULL SATISFACTION . . . NO OBLIGATION! . . . If you prefer, order your Clipper Masonry Saw now . . . and the Clipper "Convertible" Cart when the need arises.



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● One man easily adjusts Cutting Head to desired height . . . Whether cutting 12" or 1" material. Operator's hands merely guide. Weight supported by rear Bar.

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● Makes your blades last longer . . . Because Equalizer Spring automatically cushions blade pressure whether cutting HARD or SOFT materials. Outstanding for blade economy.

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● Pull the knob—and the Cutting Head is free for finger-tip setting at any desired angle. Release the Knob—and Head is locked in the desired position.

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INDUSTRY SCRAP APPEAL BROADENED

Defense production authorities broadened the scope of their scrap metal collection drive recently when they appealed to all industry to collect "dormant" scrap. At a meeting of industrial magazine editors, December 14, in Washington, Defense Production Administrator Manly Fleischman said the new phase of the collection campaign must look to every possible source.

Mr. Fleischman based his appeal on a recent survey of steel mills' scrap inventories. Some mills, he said, were reduced to shoveling scrap from freight cars direct to the furnaces. Others were down to one day's supply. He also pointed to a chart showing that for the past 15 months the mills' consumption had been exceeding inventories.

This new appeal includes non-ferrous scrap, Mr. Fleischman announced. New sources for old lead, zinc, aluminum, copper and other metals are necessary if mills in those fields are to continue at present high production rates.

The importance to all industry, large and small, was stressed. The present crisis, Mr. Fleischman warned, is particularly important to non-defense producers. "Since nothing must be allowed to interfere with military production, this reduced steel output (threatened by the scrap shortage) would immediately affect civilian production," he emphasized.

Other speakers at the conference outlined programs to bring the drive to the attention of all industry. Publicity will be based on the theme "Where there is business, there is scrap." Speakers suggested that each business appoint one scrap gathering executive. He should have the support of top management, and authority to say what is and is not scrap.

Although no appeal on a price basis is planned, it was announced that the Office of Price Stabilization had increased the ceiling on ferrous scrap approximately $20 a ton over its former figure of $42. Price, however, varies with the area.

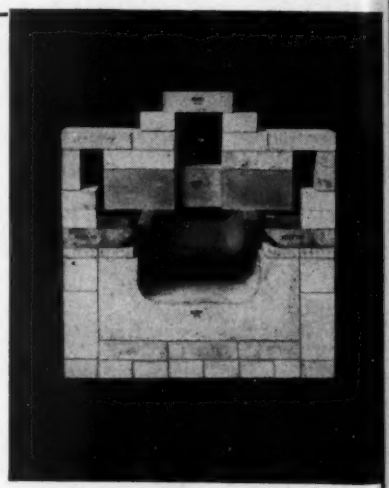
Disposal of industry's scrap is being facilitated by creation of county scrap mobilization committees which will be able to give industry the names of buyers in their vicinity. Other information sources suggested were chambers of commerce, garage and farm implement men, and telephone directories.

The conference also heard the rule-of-thumb that one ton of scrap collected outside the steel mill would enable production of four tons of new metal.

The appeal for "dormant" industry metal is being launched at the same time as a farm campaign. Other sources being tapped are battle fields in the former Pacific theatre, sunken shipping in foreign waters, and abandoned military equipment in Alaska. The emphasis on these "high cost" sources was cited as another piece of evidence that the normal suppliers could not satisfy the voracious appetites of mills now producing at "100-plus" per cent capacity.

• The Plant Maintenance Show and Conference for 1952 will be held at Convention Hall in Philadelphia, January 14 through 17.

Cleaner Glass, Low Maintenance with **CRYSTALITE Forehearths**



REMMEY CRYSTALITE (mullite-bonded mullite) is produced in all shapes necessary to make up the forehearth assembly. Burner blocks, cover blocks, channels, spouts, tubes, plungers and orifice rings are built to meet specified requirements. These CRYSTALITE parts mean better, more efficient production by offering:

★ Accuracy in formation to eliminate time-wasting adjustments.
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★ Rigid control through each production phase for uniform quality and dimension accuracy.

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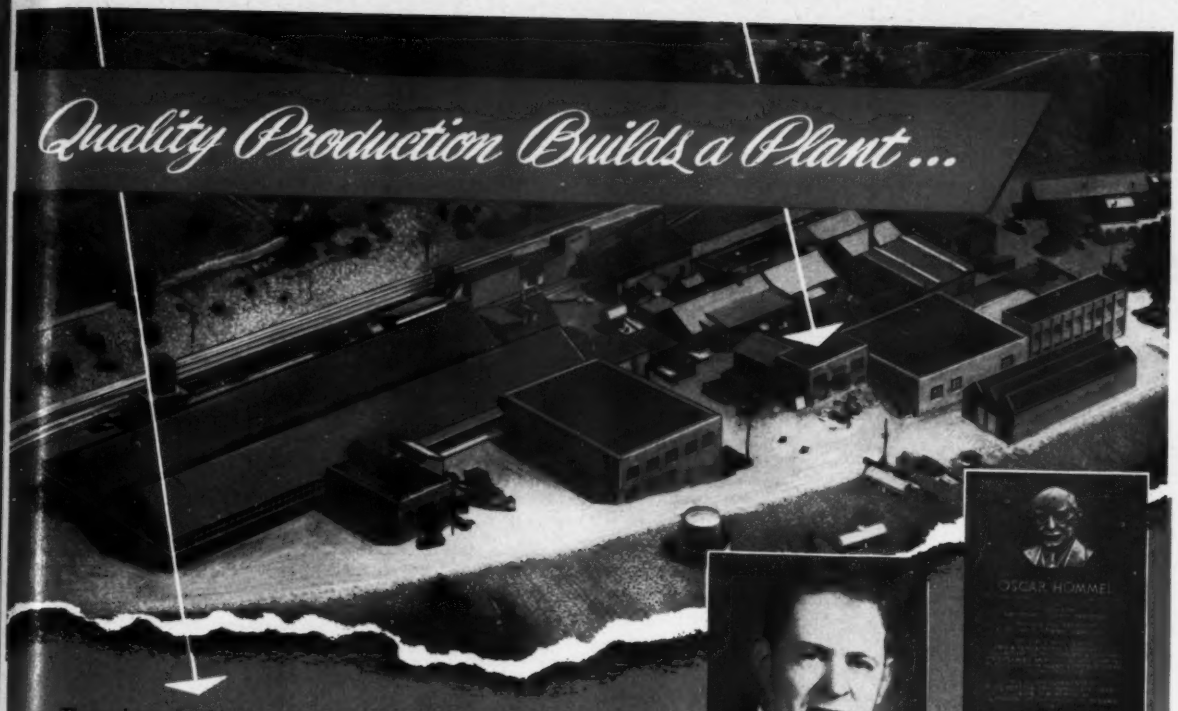

Throughout its history, The O. Hommel Company has steadfastly maintained its original policy of manufacturing quality ceramic colors, oxides, frit and stains, and rendering service to the ceramic industry. Seasoned by three score years of research and production, The O. Hommel Company operates in its 61st year on the same principles of integrity and fair business practices that have contributed to its growth. Less than one-half of one per cent of corporations in business today were doing business in 1891. There is no substitute for more than three score years of research and manufacturing experience.

Ernest M. Hommel
President

A remembrance plaque of Oscar Hommel, founder

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Glass Colors—for Spraying, Brushing and Squeegee, either Hot or Cold.
Sulphide Resisting—for Lighting Fixtures and Refrigeration.
Acid Resisting—for table and laboratory glass ware.
Alkali Resisting—for tableware, beverage and milk bottles.
Iceri—a permanent crystalline finish of sparkling beauty.
Gold—Liquid Bright Gold, Powder Gold, Paste Burnish Gold, Liquid Burnish Gold, Liquid Bright Platinum.
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THE GLASS INDUSTRY IN 1951 . . .

(*Continued from page* 20)

tation for thorough work and her established record of accomplishments in the field of reflective coatings. The other is the rapid extension of uses of conducting glasses, even into services not originally anticipated. For example, during the year the luminous panel was announced. While this invention is the work of a different research group, nevertheless, conducting glass surfaces are the heart of the invention. A surprising use of electrical conducting glass not foreseen by the inventors was the introduction of this product as a heat shield in steel mills where it quickly found important applications.

The fundamental problem of the strength of glass continues to attract the attention of some of the most alert minds in glass science. Photographic studies by a new technique were made in Germany by Hubert Schardin, whose publications reached this country during the year. Further confirmation of the flaw theory was obtained by Peter Gibbs and Ivan B. Cutler using the ball impression method of H. E. Powell. Work by Stockdale, Tooley, and Ying showed what changes take place in the tensile strength of glass by water treatments. The results of these investigators can also be fitted into the flaw theory without too much shoving. Dimmick and McCormick explored the variations of fracture velocity over a wide range of temperature.

Personally, I was impressed by the frequent references by these advanced workers to the books of Henry Eyring, and while I have never read any of Eyring's works and probably would not understand them if I did, it appears that progressive researchers are deriving considerable inspiration from Eyring's theories. Scientists studying the strength of glass continue to be vexed by tensile strength of glass fibers considerably in excess of any strength theoretically possible, and while the flaw theory helps in part to bridge the gap, it does not close up all of the discrepancy. No doubt, someone who understands mathematics will someday apply some simple transformations to the formula for tensile strength of fibers, much as Einstein did to the formulas for gravitation, and come up with a relativity concept of tensile strength that will be applicable to all sizes of test specimens.

Durability continues to be the perennial subject of investigation. Of several papers on the subject, two will be mentioned. Scott Anderson and D. D. Kimpton found that acid leaching does more than dissolve some of the material. Apparently, a skeleton of undissolved material is first formed which later rearranges itself. Glass leached with acid, therefore, has three zones: the unaffected glass, freshly formed skeleton, and on the surface rearranged film. These changes can be followed by precise measurements of the index of refraction.

Mary M. Aposhian and Norbert J. Kreidl study the use of titania additions to improve stain resistance of optical glass high in lead. Several authors had previously pointed out that titania additions could improve the durability of lead glass, but the present investigators undertook a quantitative study to determine the most favorable amounts to balance improved durability against loss of refractivity.

Other properties of glass have been the subject of several papers. D. E. Sharp and L. B. Ginther have worked out factors for specific heat applicable over a wide range of compositions and temperatures. Specific heat is important in engineering calculations and, heretofore, reliance had to be made on scattered data applicable to limited temperatures and compositions or on factors definitely obsolete. A method for determining thermal diffusivity in glass was published by A. F. Van Zee and C. L. Babcock. This method, based on the lag between an impressed heat and a measured temperature, determines the combined effect of conductivity and radiation, which combination is what most people want to know about. The diffusion of ions in simple glass was studied by James R. Johnson, Robert H. Bristow, and H. H. Blau who used radioactive tracers. The experimental data were then applied by the authors to an interpretation of the thermo-dynamics of the network.

The questions raised by Anita Winters during her sojourn to the United States several years ago are still the subject of investigation. Madam Winters-Klein proposed some novel theories about annealing and compacting, and although these theories were largely not confirmed, they did serve as a stimulant to research along new lines. This year, P. W. Collier attempted to shorten the compacting time necessary to stabilize precise optical glass by the use of pressure. No effect could be found up to 31 atmospheres, in spite of the fact that such an acceleration could have been expected from Winters-Klein theory.

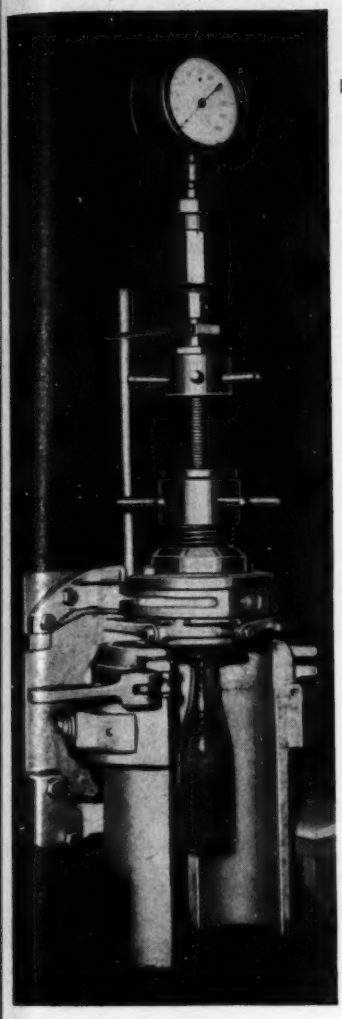
Any measurement that moves into a new decimal place is always interesting no matter what the measurement is. This year, James B. Saunders measured the contour of an optical surface one decimal beyond anything previously done. By placing an interferometer in a gas chamber and varying the pressure of the gas, ten or fifteen interference lines can be developed where there was only one before. On a reduced scale, this method would be equivalent to drawing in contour lines on a topographical map at intervals of ten feet of elevation instead of 100-foot intervals.

A new phase of glass technology which has been growing up in recent years is the subject of dishwashing. The rapid introduction of new detergents has created a problem of the action of detergents on glass surfaces. An example of studies directed towards this problem is the report by James W. Hensley on the adsorption of phosphate ions on glass surfaces. Tagged phosphate ions were used in this study to show that adsorption of phosphate ions on a glass surface is slight until the glass has been attacked by an alkaline solution.

More and more work on the washing of dishes and glassware can be expected, and as the problems cut across the activities of china and glass manufacturers, detergent manufacturers, and makers of ceramic colors and dishwashing machines, as well as involving sanitation and mass marketing, progress will necessarily be slow. Each group of specialists must learn something of the terminology and methods of the other.

For many years, Edouard V. Borel has studied the application of electric melting to glass furnaces with the result that such practice is now considerably used in Switzerland. An article by Borel on the engineering aspects of electric melting is not unexpected, nor is his thorough and authoritative treatment. What makes his

(*Continued on page* 44)



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THE GLASS INDUSTRY IN 1951 . . .

(*Continued from page* 42)

article newsworthy are two parenthetic paragraphs in which he points out that electricity lends itself readily to the making of glass in two stages wherein the melting and the refining operations can be separated. Separation of the making of glass into its two logical processes will be revolutionary when it is achieved. The economic benefits are apparent after a little reflection and have often been pointed out by authors endowed, perhaps, with more imagination than experience. The endorsement of the principle by a man who has both faculties is not to be overlooked.

Knowledge of the structure of glass which began with the work of W. H. Zachariasen and B. E. Warren has now reached the point where practical applications can be made in actual glass manufacture. In unravelling the secrets of atomic constitution of glass and the application of this knowledge to glassmaking, the British have taken the lead. Examples are the recent work of Cole which gave the first workable hypothesis of the color of sulfide amber; and the thorough work of Prof. Harry Moore on the structural relations of iron and color. These papers were published before 1951 but are included here because the full imports of the discoveries are still being realized.

Of the British journals which reached our shores during the year just past, much of the space has been given to magnetic effects, electron spins, and that sort of thing. These properties are of importance in determining the type of bond. Only a few years ago, chemists were being criticized for spending too much time inside of the atom. How wrong these critics were has not been demonstrated. The British have set out to prove that all of the properties of glass can be determined by the spatial arrangement of the atoms and the type of bond linkage between the atoms. Distasteful as such business might be to oldtimers, the developing knowledge cannot be ignored.

An entirely different answer to the same yearning for knowledge of the internal structure of glass is being developed by the research group, headed by J. V. Fitzgerald. These researchers are studying the small range in which glass departs from Hooke's law and ceases to be a perfectly elastic solid. When, where, and why a glass is not perfectly elastic furnishes clues to its structure and, like the British research, will lead to better understanding of the atomic configuration. An elasticity differs from magnetic properties in one respect which will appeal to Americans. There is more possibility of immediate practical applications. The phenomena that affects the elastic properties of glass are closely associated with such practical matters as electrical conductivity, chemical durability, and breakage.

Future Prospects

Prophecy and prediction can best be left to the writers of scientific fiction. However, from a study of events during the past year, there is nothing to indicate any departure from well-established trends. The following may be expected with considerable confidence.

1. A gradual socialism by taxation, with the stresses and strains that always accompany a social change.

2. A managed economy, and since an economy can be managed in only one direction, this will be an expanding economy. Greatest expansion will be in the newest uses for glass, namely, fibers, energy radiation, such as lighting and heating, and selective energy absorption. Less expansion can be expected in the older applications of glass such as containers and, after the flight from the dollar has run its course, windows.

3. Continued basic research on the constitution of glass and the use of new tools to pry open their secrets.

L-O-F ISSUES NEW SALES AID BOOKLET

Field sales personnel of Libbey-Owens-Ford Glass Company have been advised that a new booklet, "For Greater Profits", has been added to the company literature to aid in merchandising window glass.

The booklet covers pictorially the production process which involves an exclusive method for horizontal annealing which makes window glass cut easier and cleaner, shows cutting methods, suggested stocks of popular sizes, provides working drawings for a display rack which will sell glass, and drawings for storage facilities.

PERSONNEL CHANGES AT HARBISON-WALKER

J. C. Willey has been appointed assistant to the President of Harbison-Walker Refractories Company, according to an announcement by E. A. Garber, President. The son of former President Raymond Willey, he has worked with the company in a variety of operating and executive positions since 1934.

A graduate of Andover and Princeton, Mr. Willey started with Harbison-Walker in an operating job in the Clearfield Works, where he later became a foreman. After working for some time at the Hays Works, he was appointed superintendent of the Clearfield #3 Works in 1942. In 1947 he was transferred to the company's home offices in Pittsburgh, where he served as assistant to the Vice President.

Also announced were three personnel changes in the sales department. H. G. Hart, formerly of the Portsmouth, Ohio Sales District, has been transferred to the new Specialties and Retail Department in Pittsburgh; Floyd A. Pearce, formerly of the Pittsburgh Sales District, has been transferred to Portsmouth to replace Mr. Hart; and E. A. Olson has been appointed to the Pittsburgh Sales District as replacement for Mr. Pearce.

• Ball Brothers Company will occupy Space B-15 at the Canning Machinery and Supplies Show to be held in Atlantic City, January 19 to 23. The company will maintain headquarters at the convention in Suite 1010-1012 at the Claridge Hotel.

• William I. Burt, Vice President-Manufacturing of The B. F. Goodrich Chemical Company, has been elected President of the American Institute of Chemical Engineers for 1952.

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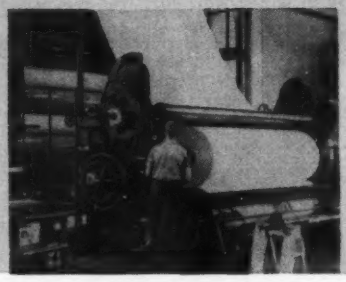

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Formaldehyde
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G.C.M.I. MEETING . . .

(*Continued from page* 23)

container industry which have importance because of their economic aspects have received attention; second, the Committee has devoted attention to the many packaging problems arising as a result of changes or proposed changes in the rules, regulations, and specifications of various groups such as the railroads and Government agencies; third, advances have been made in the direction of the Committee's long-range packaging research and development program."

With regard to paperboard supply, Mr. Wells pointed out that in general the tightness of supply of paperboard had diminished during the summer and early fall months, but cautioned that original steps which were proposed in the bulletin could well serve as a guide for board conservation should the board supply become more critical in future months.

Other matters reported on by the Committee were 1-Way beer bottle carriers, a proposed liquor package survey by Joseph E. Seagram & Sons, Inc. and packaging research and development projects being carried out at the G.C.M.I. Packaging Research Lboratory.

RESEARCH DIGEST . . .

(*Continued from page* 34)

metallic oxide. These affinities change with the different metals and temperatures used.

It was found that amber soda-lime glass gave different persistence values than did clear soda-lime glass although the adherence-temperature values checked within experimental precision of the test. It was observed that the clear glass beads tend to flatten out more than the amber glass beads did upon striking the metal surface. This was thought to be due to the fact that the amber soda-lime glass contained a large number of gas inclusions which made the molten glass beads resilient with a tendency to bounce as they dropped onto the heated metal surface.

The more intimate contact of the clear soda-lime glass with the metal surface provided a better heat transfer giving a higher local temperature which, in turn, caused better absorption of the metallic oxide. Hence, the clear soda-lime glass produced a faster rate of erosion of the metal surface. This rough surface formed by erosion contained peaks and ridges. The temperature of these peaks and ridges was increased sufficiently by the molten glass beads to cause the adherence of the glass to the metal.

ARIES & ASSOCIATES TO OPEN TOKYO OFFICE

R. S. Aries & Associates has announced the opening of a branch office in Japan. H. F. Alber, Chemical Engineer and Consultant to the Japanese Government, has been named to head the office to be located in Tokyo.

The expanding activities of the Aries organization in countries of the Far East, especially in Japan, has necessitated the organization of permanent representatives in that area.

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URBANA GLASS CONFERENCE . . .
(*Continued from page* 29)

Mr. Lyle's remarks on the principles underlying the operation of the enfolding batch charger were of particular interest. This charger, which is currently used for end-port tanks, apparently encases some of the batch in the glass which is an important factor in promoting rapid melting.

A modern batch plant was described by John L. Klug, John L. Klug Corporation, with respect to equipment, capacity, and conveying. The importance of minimizing leakage by seals was emphasized as well as the disadvantages of using wet cullet. Mr. Klug stated that although segregation is not the single cause for bad glass, it is always good practice to keep batch bins nearly full and maintain a level surface so as to minimize the flow of batch. The statement that no complaints have been experienced with belt conveying was of interest to many in the audience, some of whom have always questioned this method of handling mixed batch.

The discussion of this series of papers included comments on the use of vibrators, multiscales, tape recording of weights, and the caking of materials in the batchhouse.

Training within industry is progressing faster than at any time in the past, not for the purpose of experimentation, but because of bare necessity. The increasing scarcity of engineers makes it imperative that manufacturers develop men already on the job by means of supervisor development and training programs. D. E. Shafer, Owens-Corning Fiberglas Corporation, presided over this final session of the two-day meeting.

R. C. Lawson, of Hartford-Empire Company, pointed out the advantages and disadvantages of adequate programs for coordinating the various factors involved in operating a typical glass forming machine efficiently. There are at least 70 possible changes in equipment and settings that must be watched, of which many are potential causes for trouble, and are variables that must be controlled. Mr. Lawson stressed the importance of job change orders, and the value of a training program for job change crews.

"The Development of Supervisors" was ably discussed by Harold Mayfield, Owens-Illinois Glass Company, who pointed out that making a man a supervisor involves a brand new occupation with a new set of skills. Supervisor development involves the studies of human abilities that in some instances may outweigh technical knowledge. The Supervisor must have a knack for the development of men by having the power to develop their interest in the job. He himself must be interested in the man and realize that rather than changing other people, they must change constructively by themselves. The problem of changing men is one of unusual difficulty because of an emotional involvement that is difficult to change. Mr. Mayfield stressed the value of "participation training" in which discussion plays a very important part, and helps clear away the obstacles to good performance, and avoidance of bottlenecks.

"The Why, How, and How Much of Job Training" was presented by Fred M. Crandall, Owens-Corning Fiberglas Corporation, who stated that "Training doesn't cost—it pays." Job training is an investment, with the "odds" too big to turn down. Business men are accustomed to spending money for better tools, and a training program is actually a tool for management, he stated.

In installing a training program, the project should not be cheapened to the extent that it will not work. Mr. Crandall pointed out ten advantages to a job training program, the first of which was the reduction of learning time. Other advantages were that the program forces adoption of standardized methods, reduction of turnover, waste, misunderstandings, and accidents. In addition, both quality and morale are improved, and production is increased.

Thirteen selected factors for training a man were stressed in the order listed; namely, maturity, intelligence, adaptability to change, initiative, industriousness, enthusiasm, good health, speaking ability, tact, tolerance, desire to help other people, self confidence, and humility.

Mr. Crandall's plan for setting up a job training program consisted of seven steps which were about as follows: (1) Select a competent man for the over-all responsibility; (2) Train that man; (3) Have him train those who will actually carry out and supervise the instructions; (4) Break down all jobs for instructional purposes; (5) Organize the job breakdowns; (6) Supervise the program and the individuals in it; (7) Report the results to management.

The costs to be considered included the following: (1) Training man's time; (2) Training man's original training; (3) Keeping training man up to date; (4) Training supervisors and job instructors; (5) Developing the program; (6) Non-productive time; (7) Training equipment; (8) Materials and supplies consumed by trainees.

Assuming that the common sense point of view towards production is often blissfully negative, industry must jump on the bandwagon and develop supervisors as is being done in defense plants.

PPG'S SOLEX GLASS EXPECTED TO REPLACE COLORLESS GLASS

According to a prediction by Richard B. Tucker, Executive Vice President of the Pittsburgh Plate Glass Company, ordinary colorless glass will eventually be replaced with a new greenish tint glass which absorbs the sun's heat, reduces eyestrain, and keeps fading and bleaching of fabrics to a minimum. Mr. Tucker said, "Every major automobile manufacturer serviced by Pittsburgh Plate Glass Company will offer this advance in glass technology in their 1952 lines and it will also be widely used in public building construction."

The new flat glass product, called "Solex," may be bent, laminated, or tempered for use in practically every known type of flat glass application. Made specifically to reduce the intensity of solar radiation, it actually takes the heat out of sunshine, but does so without sacrificing the light transmission characteristics of high quality glass.

Solex absorbs the red portion of the solar spectrum so that the light transmitted through it is the easier portion on the eyes. While it absorbs most of the solar infrared and ultraviolet rays, at the same time it transmits adequate soft daylight for clear visibility. Occupants of Solex glazed interiors, especially if they sit adjacent to windows in direct sunlight, are cooler and more comfortable. A room glazed with Solex is 10 to 20°F. cooler than a room with ordinary glass.

A. G. DOLL OF LYNCH TO VISIT SOUTH AMERICA AND AFRICA

Andrew G. Doll, Vice President of Lynch Corporation and Sales Manager of the Glass Machinery Division, left this country around January 1 on an extended trip to call on glass manufacturers of South America and Africa. Taking a plane from Miami, Mr. Doll will fly to San Juan, Puerto Rico, Caracas, Venezuela, and Trinidad, and then to Rio de Janeiro.

While in South Africa, Mr. Doll plans to visit several glasshouses before returning to Dakar for his return trip to Rio via Recife. During his four-month trip, Mr. Doll will call upon approximately one hundred glass plants.

CAMBRIDGE WIRE ANNOUNCES NEW MATERIAL FOR CONVEYOR BELTS

The Cambridge Wire Cloth Company has announced the introduction of Cambriloy-Al, a new material for fabricating woven wire conveyor belts for annealing and decorating lehrs in glass manufacturing plants.

Cambriloy-Al is a specially developed alumimum-steel alloy surfaced wire which offers an extremely high degree of resistance to oxidation and heat scale, causes of deterioration of ordinary steel conveyor belts used in such lehrs. When placed in operation, the heat of the lehr produces a hard coating of aluminum oxide on the surface of the wire. This oxide coating inhibits the formation of further and more penetrating layers of oxidation. The aluminum coating actually alloys with the steel to form an alloy surfaced wire.

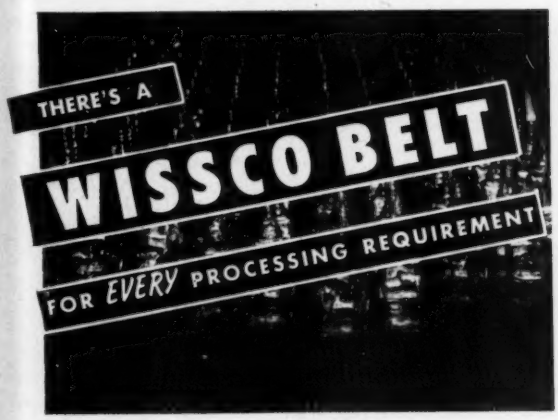
Lehr belts woven from the new material have been on field test for more than a year and results to date indicate comparable performance to the previously used low-chromium steel alloys for such belts.

CADMIUM MEETING

Relaxation of the use controls of M-19, the cadmium order, was recommended by the Cadmium Producers and Cadmium Distributors and Consumers Industry Advisory Committees meeting jointly with the National Production Authority.

In urging relaxation of the use limitations of M-19, the committee pointed out that approximately a two-months' supply of cadmium is now in the hands of producers and that, on the basis of present estimates, accumulations will increase in coming months. It was also noted that military requirements have not been as heavy as anticipated.

The committee approved the retention of current inventory controls, urging also that M-19 be relaxed in such a manner as to permit its reimposition whenever such action becomes necessary. NPA indicated that the committees' recommendations with respect to M-19 would be considered.



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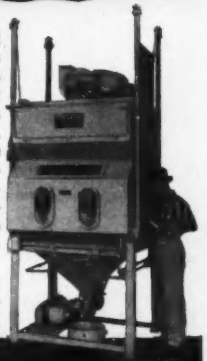

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T. C. WERBE, SR., LYNCH BOARD CHAIRMAN, DIES

Thomas C. Werbe, Sr., Chairman of the Board of Directors of Lynch Corporation, died of a heart attack on December 5 at the age of 68.

Mr. Werbe, who founded the Lynch Glass Machine Company in 1917, served as President of the Corporation until 1949 when he became Chairman of the Board. He was also Director of Lynch International, Ltd., of London, England, which was established in 1950.

In addition to serving as Chairman of Lynch, Mr. Werbe was trustee of Hanover College, President of the Board of Directors of the Anderson, Indiana Community Chest Fund, Vice President and Director of the Citizens Banking Company, Director of the Indiana Manufacturers Association, Director of the Anderson YMCA, and a member of the board of trustees of the First Presbyterian Church.

OWENS-CORNING APPOINTMENTS

The designation of a sales manager for its General Products Division and major rearrangement of assignments of two vice presidents have been announced by Harold Boeschenstein, President of Owens-Corning Fiberglas Corporation.

Ben S. Wright, Vice President since 1949 and General Sales Manager since 1947, was reassigned as Vice President in charge of Purchasing and Trade Relations.

E. J. Detgen

E. W. (Pat) Smith, who was appointed Vice President and Director of Merchandising last May, was reassigned as Vice President in charge of sales branches and training programs.

Edward J. Detgen was named Sales Manager of the General Products Division. Mr. Detgen joined Owens-Corning in 1945 as Sales Manager of the firm's Building Materials Division. In his new capacity, he assumes leadership for sales programs in the General Products Division.

Mr. Wright's new duties embrace purchasing and trade relationships with national accounts and procurement of materials for Fiberglas manufacturing operations in numerous plants.

Mr. Smith joined Owens-Corning in 1949 and has been in charge of merchandising and advertising programs, and sales recruiting and training activities in the company's general sales department.

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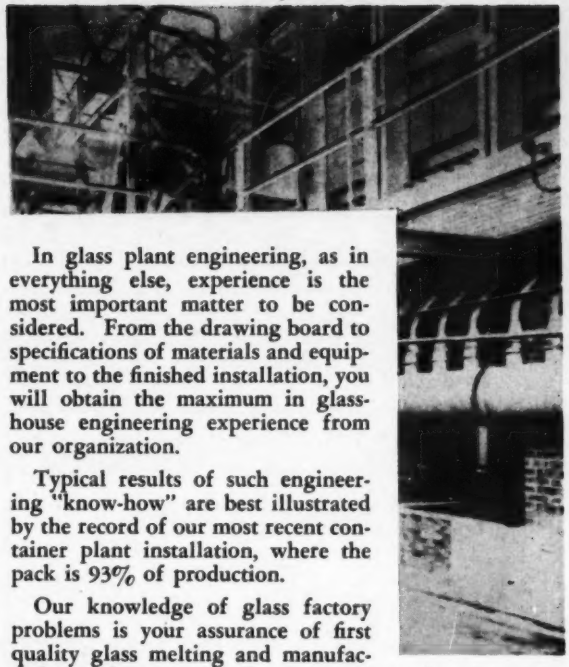
CORNING APPOINTMENTS

Four executive appointments were announced by Corning Glass Works in connection with major organization changes in the company. The Consumer Products Division, which since 1948 has been combined with the Technical Products Division, has been reestablished as a separate division of the company.

John Carter, former General Manager of the New Products Division, has been named General Manager of Consumer Products. Thomas H. Truslow, Jr., former Sales Manager of the combined Divisions, succeeds Mr. Carter.

Campbell Rutledge, Jr. has been appointed to the newly created position of Assistant General Manager of Technical Products, and R. H. Mariner succeeds Mr. Rutledge in his former position as Sales Manager of the Standard Products Department.



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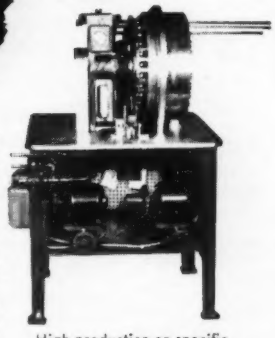

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